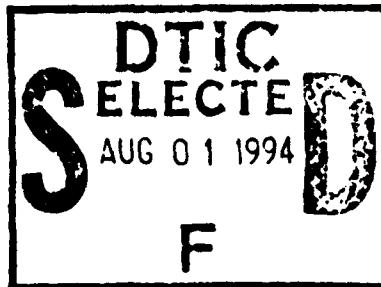


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18 October 1961

SCIENCE AND TECHNOLOGY IN THE LATVIAN  
SSR ON ITS TWENTIETH ANNIVERSARY

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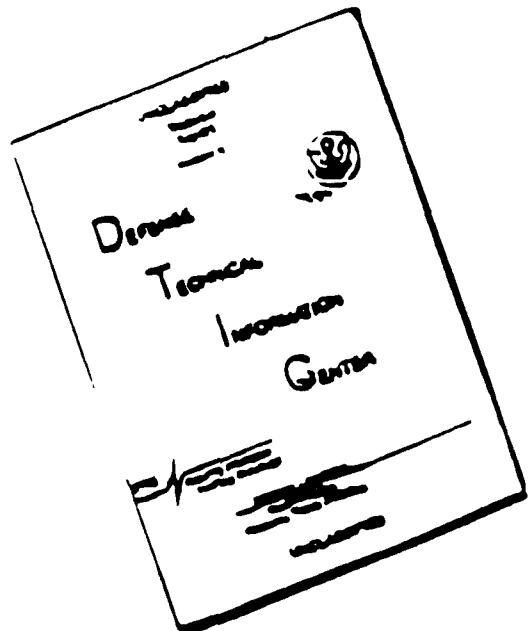
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## FOREWORD

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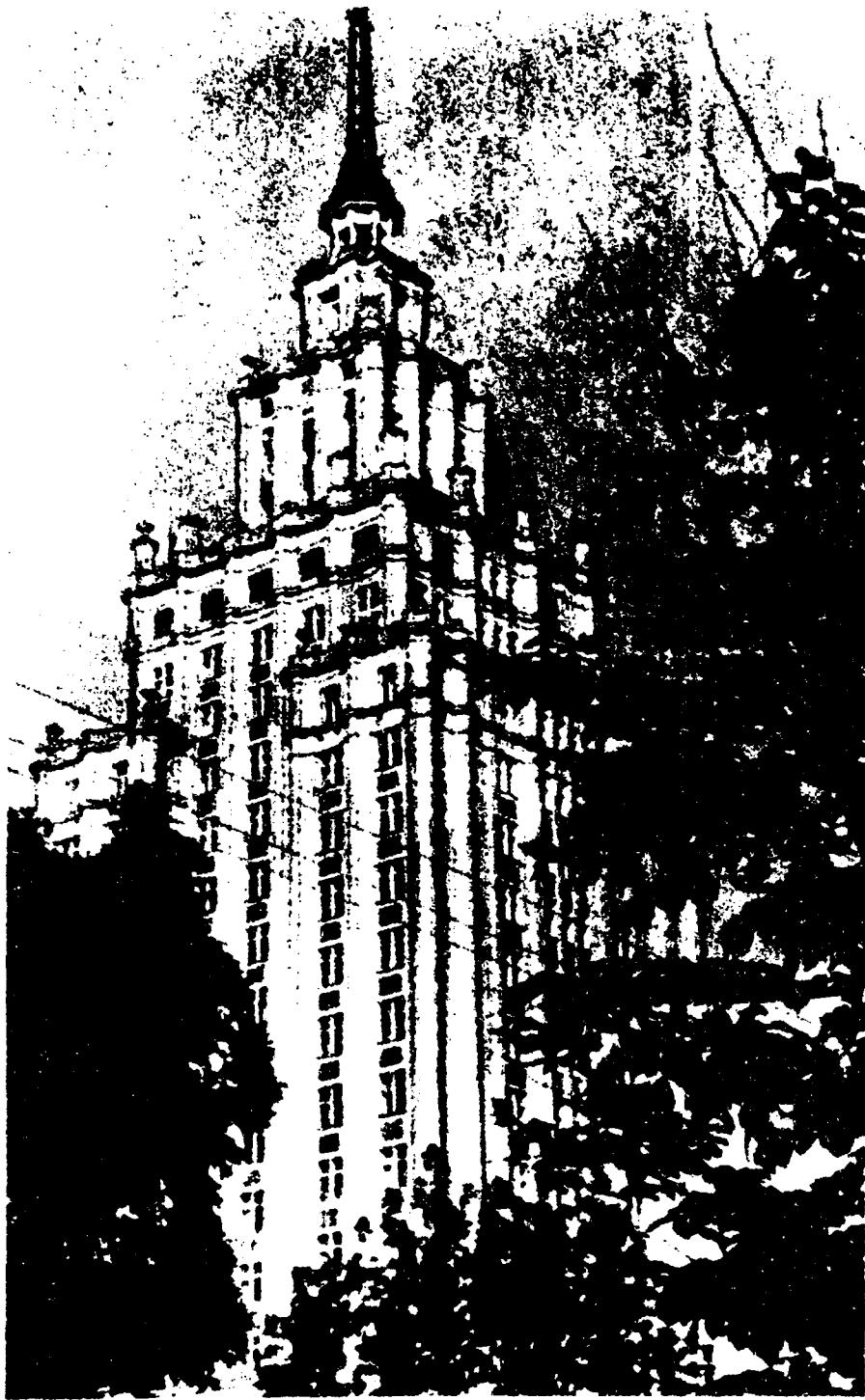
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SCIENCE TECHNOLOGY IN THE LATVIAN  
SSR ON ITS TWENTIETH ANNIVERSARY

[Following is a translation of selected articles from Izvestiya Akademii Nauk Latviyskoy SSR (News of the Academy of Sciences of the Latvian SSR), No 7 (156), Riga, 1960. Authors and pages will be indicated at the beginning of each article.]

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**Skyscraper of the Academy of Sciences, Latvian SSR**

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## A NOTEWORTHY DATE

This year is the 20th anniversary of the establishment of Soviet rule in Latvia. On the 21st July 1940 the National Diet, carrying out the will of the Latvian working people, voted in Soviet rule and decided on the entry of the Latvian S.S.R. into the friendly family of nations which comprises the Soviet Union.

The Socialist revolution in Latvia, as also in Lithuania and Estonia, was one of the first revolutions in the world where the victory of the proletariat over the bourgeoisie was achieved without an armed uprising, by peaceful means.

In 1916, V.I. Lenin wrote: "It cannot be denied that in certain exceptional circumstances, for example in some small state after the accomplishment of the socialist revolution by a large neighbor, a peaceful abdication by the bourgeois government is possible, if it is convinced of the hopelessness of resistance and if they prefer to keep their heads".

This foresight of the great Lenin was proved correct in the socialist revolution of 1940 in the Baltic. Bourgeois Latvia, like other Baltic countries, proved to be a weak link in the system of imperialism. There had been created within the country a relationship of class forces which was favourable to the proletariat. The great example of the U.S.S.R., the first socialist state in the world, had a powerful revolutionizing influence on the workers of Latvia and inspired them in their struggle with the bourgeois dictatorship.

The victorious struggle for the establishment of soviet rule in Latvia was carried out by the proletariat allied with the poorest peasantry and helped by the middle peasants.

The struggle of the workers of Latvia for Soviet

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rule was led by the Communist Party.

The wise foreign policy of the U.S.S.R. and an abundance of her troops on the territory of Latvia saved the latter from the threat of imperialist intervention and destroyed the calculations of the counterrevolutionary bourgeoisie to foment a civil war.

The victory of the socialist revolution in Latvia was made easier because it was achieved at a time when the second world war, which involved the chief capitalist states of Western Europe, was beginning.

The victory of the socialist revolution of 1940 in Latvia was also helped by the historical experience of revolutionary struggle of the workers and peasants of Latvia together with the Russian people and the other nationalities of Russia against tsarism and the bourgeoisie. The proletariat of Latvia established their rule in the country twice, in 1917 and in 1919. The establishment of genuine popular rule in Latvia was supported by wide masses of workers and by the Latvian riflemen. This is proved by the results of the elections to the Constituent Assembly in the fall of 1917, at which time the great majority of the soldiers of the Northern front and the population of Latvia voted for the Bolshevik Party. On the Northern front 828,651 electors took part in the voting. 465,581 of them voted for card No. 5 of candidates from the Russian Social-Democratic Labor Party (Bolsheviks), led by V.I. Lenin. An overwhelming majority (205,954 votes) in the 12th army went to the Bolsheviks. 90% of the men of the Latvian rifle regiments voted for the Bolsheviks. 136,080 of the inhabitants of Vidzem took part in the elections; of these 97,781 voted for card No. 3, the Social-Democratic Party of Latvia, led by P. Stuchka.

Historical facts, in particular the results of the elections, incontrovertably demonstrate that the toiling masses of the Latvian people chose Soviet rule and followed the Bolsheviks in 1917.

Only as a result of armed intervention by foreign imperialists were the nationalist bourgeoisie able to suppress the Soviet rule in Latvia and establish their own rule. The idea of Soviet rule always lived in the consciousness of the Latvian working class and the toiling peasantry. The experience gained in the previous revolutionary struggle helped towards the establishment in 1940 of Soviets as the state form of the dictatorship of the proletariat in Latvia.

The economic, political and cultural interconnections between the Latvian people and other peoples of the

U.S.S.R. formed the grounds for the fact that the Latvian workers, in addition to the demands proclaimed by the Soviet Government, raised the demand that Latvia should enter the Soviet Union as an allied soviet socialist republic. This reveals the historical understanding of the Latvian people of the common interests of their country and those of the peoples of the Soviet Union.

With Lenin in their hearts and carrying his banner in the cruel battles of the great war for the fatherland, the workers of Soviet Latvia defended their country together with all the Soviet peoples. With Lenin in their hearts and according to his plans they built socialism. With Lenin in their hearts and directed by the all-vanquishing teaching of Marxist-Leninism, the Latvian people is today building the bright world of communism together in the family of fraternal soviet nations.

The movement of mankind towards communism is happening as Lenin foresaw it. Socialism was victorious first of all in one country - the U.S.S.R.. Then capitalism loses other countries - the world system of socialism begins to form. In our time the unfading ideas of Marxist-Leninism possessed the minds of many hundreds of millions of people and have become an enormous power.

This glorious date - the 20th anniversary of Soviet Latvia - is memorable for the workers of the Republic because of the magnificent victory of the Soviet Union and the growth of her might and international authority.

The program worked out at the 21st Congress of the Communist Party of the Soviet Union for the building of communism in the S.S.R. has opened before our country new and majestic prospects. Our socialist fatherland, raising ever higher the holy banner of Lenin, goes from victory to victory.

The sending off of the Soviet sputniks and luniks, the launching of the first atomic icebreaker "Lenin", the creation of the world's best airplanes and the construction of hydro-electric stations of enormous power has demonstrated to the entire world the creative genius and power of the Soviet nation. In comparison with pre-revolutionary times, the gross output of industry in the U.S.S.R. was more than 40 times greater. Production of the means of production had risen by 93 times, and the production of machine tools and metal manufactured goods had risen more than 270 times. In industrial production, the Soviet Union now stands first in Europe and second in the world.

The steadfast application of Lenin's policy of peaceful coexistence has guaranteed to our country the

worldwide authority of a consistent fighter for a weakening in international tension, for peace throughout the world. The state visits of the Chairman of the Council of Ministers of the U.S.S.R., N.S. Khrushchev, to foreign countries has convincingly demonstrated that the peoples of these countries warmly appreciate and support our peace-loving policy.

The resounding successes of the Soviet Union are a result of the self-denying work of all the peoples of our indivisible fatherland, united by the Communist Party into a friendly, fraternal family. In the 20 years of her existence, Soviet Latvia has made a worthy contribution towards the strengthening of our country.

Speaking at the meeting of many thousands of workers in Riga on the 11th June, 1959, N.S. Khrushchev said "After the Baltic Republic entered of their own free will as equals into the great fraternal family of the socialist nations of the Soviet Union, wide prospects opened before them for the development of their culture and economy. In the post-war years Latvia, Lithuania and Estonia have taken great steps forward in their development. From being predominantly agrarian, as they were under the rule of the bourgeoisie, these republics have become industrially developed. It is enough to say that in comparison with the pre-war period, industrial production in 1958 had increased in Latvia 8.6 times, in Lithuania 8 times and in Estonia 9.3 times."

Transforming the decisions of the 21st Congress of the Communist Party of the Soviet Union into life, the workers of the Latvian S.S.R. have achieved new labor successes in the first year of the seven-year plan. Triumphantly marking the 20th anniversary of Soviet Latvia in the fraternal family of the Soviet nations, they are toiling in self-denial in order to achieve the great tasks of the seven-year plan and are successfully building a communist society.

## THE ACADEMY OF SCIENCES ON THE 20TH ANNIVERSARY OF SOVIET LATVIA

by K. Plaude

pages 9-24

When the Latvian people led by the Communist Party overthrew the bourgeois fascist government in 1940 and established Soviet power in Latvia great perspectives were opened up for the development of the national economy and culture in Soviet Latvia. In 1945, after the victory over the Hitlerite invaders, the Soviet government decided to organize the Academy of Sciences of the Latvian SSR. The first Academicians and Corresponding Members of the Academy were elected from the number of scientists in advanced educational and scientific research institutes. One of the most eminent representatives of the scholars of Latvia — Academician P. Lejins — was nominated President.

By February 1946 the Academy of Sciences comprised 15 scientific research institutes, the Central Library, and the Rainis Literary Museum. Later, in 1956, three scientific research institutes were transferred to the Ministry of Agriculture of the Latvian SSR. Several new institutes were subsequently set up — the Institute of Biology (1951), Institute of Organic Synthesis (1957), Institute of Mechanical Engineering (1958), and the Astrophysical Laboratory (1958). The scientific research institutes of the Academy are now grouped in four divisions: Physical and Technical, Chemical and Geological, Biological, and Social Sciences.

The Academy of Sciences USSR cooperated actively in the creation

of the Academy of Sciences of the Latvian SSR. A number of very eminent scholars took part in working out the plan and deciding the main lines of research of the scientific center of our republic. It was only through the great and unselfish assistance given by the scientists of Moscow and Leningrad that the foundations of the theoretical research of the Academy and its constructive cooperation with industry were established. If now, looking back on the great career of our Academy, we can record several achievements in various fields of scientific knowledge, it is the result of the cooperation of the scientists of our brother republics and the unflagging concern of our Party and Government for the development of Soviet science.

The creation of the Academy of Sciences led to the development of new lines of scientific research in Soviet Latvia, and to the progress of science in general and in particular fields. For the first time in the history of Latvia physicists were given the opportunity to expand research on magnetohydrodynamics and the utilization of radioactive isotopes in the national economy. Scientific investigations in the field of power engineering, mechanics, and automation were initiated. In the field of chemistry new lines of research were undertaken -- organic synthesis, physical chemistry, wood chemistry, and electrochemistry.

For the first time in the republic the principles of the all-round utilization of natural resources -- water, peat, sapropel, and minerals -- were tackled on a scientific basis and this work is progressing successfully.

Research on the flora and fauna of Latvia, soil biochemistry, medical and industrial microbiology, and virology, is being widely developed. Research doctors are providing important theoretical and experimental assistance to workers in the health service.

For the first time in Latvia the history, language, material culture, and literature of the Latvian nation are being studied on a Marxist basis by the institutes of the Academy of Sciences.

One of the most difficult problems which had to be tackled by the Academy on its inception was the selection and training of scientific personnel. In 1947 there were only 17 Doctors and 26 Candidates of Science out of a total staff of 1030 in the Academy. These figures illustrate with what modest scientific resources the Academy began its work. By 1951 we had 23 Academicians and 13 Corresponding Members; the number of Candidates of Science had increased to 63, and by 1955 their number had risen to 184. By the 20th anniversary of Soviet Latvia 295 scientific workers had advanced degrees, and 32 of them were Doctors. In the ensuing period 13 dissertations for the degree of Doctor, and 282 for the degree of Candidate, were defended by workers in the Academy of Sciences.

The Academy now has 23 Academicians and 20 Corresponding Members. Of this number, four Academicians of our Academy are Corresponding Members of the Academy of Sciences USSR, one is a Corresponding

Member of the Academy of Medical Sciences USSR, and one is a Corresponding Member of the Academy of Building and Architecture USSR.

The government is allocating considerable funds for the development of our Academy. The grant for the maintenance of institutes continues to increase. Whereas in 1946 the grant for research was 1600 roubles per scientific worker, in 1960 the grant was 14 600 roubles, i.e. it was more than ten times greater. The same can be said as regards the funds allocated for laboratory equipment. In the first year of life of the Academy the expenditure on this item was approximately 3000 roubles per scientific worker, while in the current year it has risen to 8000 roubles. An even clearer indication of the growth of the material provision for scientific research is the total grant. For instance, in 1947 the total grant per scientific worker was almost 40 000 roubles, while in 1960 it had increased to 88 000 roubles. As a result, the laboratories and sections of our institutes now have modern scientific equipment costing more than 30 million roubles.

Groups of new laboratory buildings are being built for the Institute of Building and Architecture, the Institute of Organic Synthesis, the Institute of Power and Electrical Engineering, and the Institute of Forestry Problems and Wood Chemistry. A base for the Astrophysical Laboratory is being constructed in Baldone, and a Botanical Garden is being set up in Salaspils. In the forthcoming years the construction of the buildings of the Central Library, the Institute of Biology, the Oncological Building, and other projects, will be started.

The above data indicate that considerable funds, undreamt of by the scholars of bourgeois Latvia, are being allocated from the national budget to the development of the Academy of Sciences. We need only mention that the total budget of the Academy of Sciences in 1960 will exceed 65 million roubles.

The conditions created by the Party and Government provide for the successful development of research in all branches of science. During the 15 years that have elapsed since the Academy was organized our institutes have achieved substantial results of great theoretical and practical value. Several discoveries and developments by Latvian scientists are finding wide application outside our republic and are contributing to the growth of the economic power of our country and the culture of Soviet people.

As we already noted, the organization of the Academy of Sciences in the republic led to the extensive development of research in various areas of physics. The Institute of Physics, the first in the history of Latvia, now comprises a large team of investigators who have modern laboratory equipment at their disposal and are engaged in effective research on several important problems.

We should first mention the investigations on the peaceful uses of atomic energy. Considerable work has been conducted on the



P. Lejins, first President of the Acad. Sci. Latv. SSR and M. Kadeks, first Vice-President of the Acad. Sci. Latv. SSR, with Academician A. Kirchensteins at a session of the Presidium of the Acad. Sci. Latv. SSR.

development of techniques and the designing of instruments for the application of radioisotopes to the automation of industrial processes (leader — V. Januskovskis). At the International Exhibition on the Peaceful Uses of Atomic Energy in Geneva in 1955 a collection of the Institute's radioactive instruments was demonstrated. For their achievements in this field a group of our physicists (G. Gunne, I. Taksars, A. Tumulkans, and V. Januskovskis) were awarded a Republican Prize of the Latvian SSR in 1958.

Under the leadership of I. Kirko, Corresponding Member of the Acad. Sci. Latv. SSR, considerable research has been conducted on electromagnetic phenomena. Several studies have been made on the theory of similarity and the theory of simulation of nonlinear magnetic phenomena. Among these works the studies on the theoretical principles of the method of calculation for the induction pump are of particular value.

In 1956 the Academy initiated research in the field of computer technique. A new design was worked out and the small electronic computer LM-3 was constructed. Research in the field of programming methods and computer mathematics is also being expanded.

An atomic reactor is under construction and, in view of this, a great variety of research is being conducted in preparation for investigations with the aid of radioactive elements and radioactive radiations in the fields of physics, chemistry, biology, medicine, and engineering. The possession of an atomic reactor will ensure the further, more intensive development of the work of our Academy on the peaceful uses of atomic energy. The scientists of the Academy will thus contribute substantially towards the early fulfilment of the seven-year plan for the development of the national economy.

Planned research on astronomy is also being conducted within the system of the Academy of Sciences.

An Astronomy Section led by Academician F. Blumbachs was set up in the Institute of Physics and in 1958 this section became an independent institute — the Astrophysical Laboratory. The experimental base of the laboratory is being constructed in Baldone. Our astronomers are engaged mainly in a study of the red giants. A series of valuable results characterizing the motion of a large number of stars has been obtained. Our astronomers are also taking part in radio-probe studies of the Sun and are conducting observations on its radio emission.

With the creation of the Academy of Sciences in the republic several new research institutes for the study of a wide circle of problems in chemistry were set up. Chemical research has progressed very rapidly in these institutes and several scientific schools, led by very eminent scientists, have arisen.

In the field of inorganic chemistry special mention must be made of the work of Prof. A. Kēsāns on the synthesis and investigation of borates in aqueous solution. This work was started in the very early days of the Academy. An account of this work appeared in a scientific monograph published in 1956.

As regards analytical chemistry, considerable research has been carried out under the leadership of Academician A. Ievins on intra-complex compounds of 8-mercaptopquinoline (thioxene). Also deserving special attention are the studies on the analytical application of sodium tetraphenylborate for the assay of potassium, calcium, rubidium, cesium, ammonium, thallium, and certain other substances, including aliphatic and aromatic amines and nitrogenous compounds.

L. Liepins has directed a great variety of research in the field of physical and colloid chemistry. The subjects of research include the sorption of electrolytes by solids of elementary and more complex composition, and also the kinetics and mechanism of certain heterogeneous reactions — mainly the oxidation of metals in water and aqueous solutions.



Acad. P. Deglavs, Vice-President of Acad. Sci. Latv., 58+  
for a long term.

The Latvian SSR possesses considerable supplies of nonmetallic minerals suitable for use in various branches of industry. In view of this, extensive research is being conducted on local typical raw materials, gypsum, and sands. The persistent work of a large group of chemists has revealed the theoretical principles of obtaining easily fused glazes, free of tin, lead, or boron. Research has also been carried on the possibility of producing fiber glass from local raw materials. Manufacturing processes for improving the quality of dolomite cement have been devised. The technology of production of silicates with water-repellent properties has been worked out.

In this connection we should mention the great importance of the scientific investigations of the Institute of Geology and Mineralogy for the extension of chemical research and for the development of the chemical industry of the republic. Our geologists have discovered and investigated reserves of nonmetallic minerals (Leader -- Corresponding Member V. Melnalksnis). Investigations of the distribution of heavy minerals in the sands of the coastal strip of the Baltic and the Gulf of Riga were recently started (Leader -- Corresponding Member K. Springis).

In our chemical institutes considerable work has been carried out in several areas of organic chemistry and chemical technology. One of the most important group of studies in this field is the research being conducted under the leadership of Academician P. Odincovs and devoted to the hydrolysis of vegetable material. Subsequent development of this research is ensured by the creation of a new department -- the Department of Lignin and Wood Polysaccharides -- in the Institute of Forestry Problems and Wood Chemistry. The Riga method of hydrolysis of vegetable material by the use of concentrated sulfuric acid -- a method developed by our chemists -- has met with universal approval.

As a result of the extensive studies in the field of synthesis of hydroxyaminobenzoic acids a new method of industrial production of the antituberculosis preparation PAS has been developed and adopted in practice. For this work Academicians A. Kalnīns and S. Hillers were awarded a Stalin Prize in 1951. Studies of the theoretical principles of chemical and mechanical processing of vegetable material, including the full utilization of wood waste, are being effectively developed under the leadership of Academician A. Kalnīns.

Considerable attention is being given to the means of obtaining and using 2-furaldehyde. Research led by Academician S. Hillers on the possibility of vapor-phase catalytic oxidation of 2-furaldehyde by atmospheric oxygen has given very promising results. In particular, a process for obtaining maleic anhydride from 2-furaldehyde has been devised. This method will be employed in experimental factories now under construction.

The theoretical and technological principles of nitration of 2-furaldehyde have been worked out, and a great number of nitrofuran medical preparations have been synthesized. For the development of the new medical preparation "furacillin", the organization of its production, and its industrial manufacture, a team of scientists (S. Hillers, S. Zaļjeva and A. Kalnīns) were awarded a Republican Prize of the Latvian SSR.

A new field of chemistry -- organic synthesis -- is represented in the Academy by the Institute of Organic Synthesis. Workers in this institute have synthesized for the first time many new compounds of interest as potential anticancer or antifungal agents, as reagents for noble and rare metals, or as semifinished products for the obtention of plastics. A new class of compounds possessing narcotic, analgetic, and convulsant effects, as well as compounds performing a regulative function in plants, have been discovered. Some of the several hundred substances synthesized for the first time are of interest as blood anticoagulants, agents for curing nervous diseases and hypertension, or as antifungal preparations. The technology of production of new preparations, such as etoxinol, furazolidone, ratindan, etc. has been worked out, and production has started. In 1959 Academician G. Vanags was awarded a Republican Prize of the

Latvian SSR for his investigations of the beta-diketone series and the synthesis of several new preparations.

It should also be noted that for the development and industrial adoption of rapid drying of wood materials and greenstuff, a group of scientific workers (J. Abolins, E. Mikits, K. Upmans and A. Jukna) was awarded a Republican Prize of the Latvian SSR in 1959.

In the Latvian republic peat and sapropel constitute very valuable natural wealth. The problem of the all-round utilization of peat and sapropel is being extensively developed under the direction of a scientific committee.

It is clear from the above that research in the field of chemistry and chemical technology has attained a considerable scale. A Division of Chemical and Geological Sciences has been set up in the Academy and directs the work of three chemical institutes and the Institute of Geology and Minerals. In view of this the prestige of our chemists in dealing with problems of development of the chemical industry in the republic has increased considerably.

The creation of the Academy of Sciences of the republic provided a sound basis for the development of the technical sciences. With the systematic help of the Academy of Sciences USSR a number of research institutes has been set up and a topical plan of research along the most important lines has been decided on.

The tackling of problems of power engineering in the complex of technical sciences constitutes one of the most important lines of research. These investigations, which are mainly being conducted in the Institute of Power and Electrical Engineering, are chiefly concerned with the establishment of the scientific principles of total electrification of the economy of the republic, the development of power for industry and agriculture, and the creation of new kinds of power equipment and electrical machines. The establishment of the scientific principles of the energy balance of the republic has decided the general future of the development of electrification for a long period -- until 1980.

Investigations on problems of raising the efficiency of heating systems have provided the theoretical bases for the automation of local systems of heat supply and the automation of heat transfer processes in a series of typical industries (leader -- K. Plaude). For these aims a whole range of new automatic apparatus and devices has been designed and introduced.

As we know, the only local fuel in the Latvian SSR is peat. It is natural that several laboratories of the Academy are engaged in research on the problem of its all-round utilization. Methods of intensifying peat combustion processes in low-power furnaces have been developed and highly efficient types of these furnaces have been designed. A new system of utilization of raw peat for power has been devised, and this enables the production of high-quality peat briquettes (leader -- G. Indriksons). An original method of



P. Valeskalns, Academician of the Acad. Sci. Latv. SSR, Vice-President of the Acad. Sci. Latv. SSR.

producing litter peat has also been worked out; a pilot plant for this purpose is being set up in cooperation with the Council of the National Economy of the Latvian SSR.

Research on the problem of energy supply for rail transport has provided a new, contactless automatic system of electrical supply for passenger cars, and this system is now in serial production in the PEZ factory. For the invention and design of this system a number of scientists (V. Apsitis, V. Krogeris, G. Šturmans, and E. Jakubaitis) in 1958 were awarded a Republican Prize of the Latvian SSR.

Important results have been obtained in the field of theory and practical development of synchronous generators and their automatic regulation. These results have now led to extensive research on contactless electrical machines.

The resolutions of the 21st Congress of the C.P.S.U. have settled the direction and course of the further rapid development of power engineering in our country, and hence in future the Academy will give undividing attention to power problems.

In the field of mechanical engineering a constant topic has been the automation and mechanization of industrial processes in instrument and machine construction, and the strength and resistance of machines to wear.

Research on the propagation characteristics of electromagnetic waves in the surface layer of metal has provided the theoretical principles and a design method for a series of electromagnetic instruments. These instruments permit control of the thickness of any coatings on any base and can also be used for contactless control of small linear displacements of machine components.

Considerable attention has been given to the problem of the automation of assembly processes in machine construction. Research on the use of ultrasound for the treatment of hard and brittle metals has made equally good progress.

Systematic studies of the processes involved in the so-called structural damping have provided a consistent theory which can be used to calculate the effect of various parameters of the system on energy dissipation. An account of the results of this extensive research has been given in the monograph "Problem of Structural Damping" by Corresponding Member of the Acad. Sci. Latv. SSR J. Panovko.

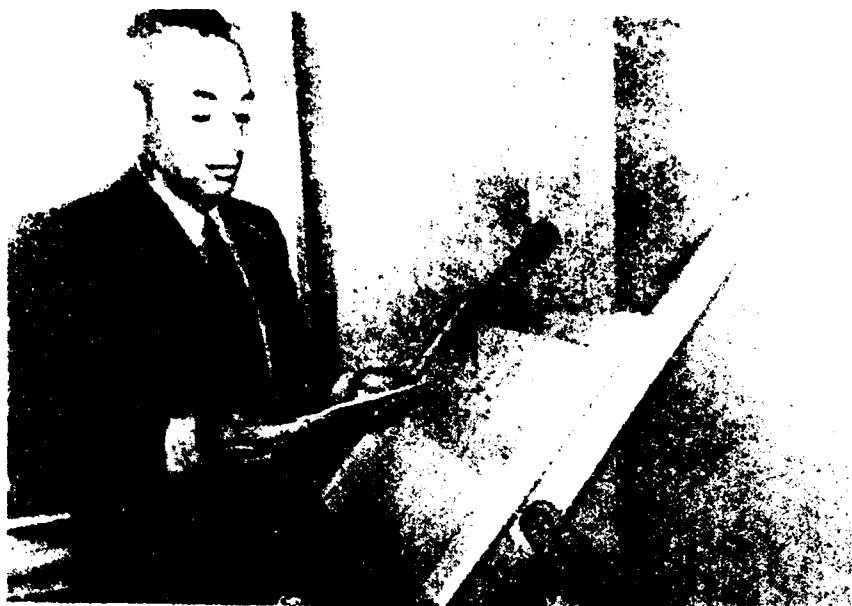
Research on the effects of friction and cohesion of metals has led to the proposal of a new method for uniting any metals. This method is based on a study of the cohesion, relative mechanical properties, and the thickness of surface films. The technology of welding metals in the solid state has been worked out, and several types of manual instruments for such welding have been designed.

Studies of nitrogen diffusion during short-term high-temperature heating by high-frequency currents have shown that such heating during the nitriding of iron enables the obtention of diffusion layers which are much harder than the metal itself.

In the Soviet Union problems of building are of first-rank importance for the industrialization of the country and the raising of the people's living standard. The creation of the Institute of Building and Architecture in the Academy system has led to extensive development of research in this field.

In recent years our scientists have been engaged mainly with the problem of concrete and ferro-concrete. A new method of concrete mixing by vibration has been devised, and a new vibro-mixer has been designed. Studies of vibro-mixing are of undoubtedly interest also for other branches of industry and agriculture. Theoretical studies of concrete technology have led to the development and introduction of several new building materials in the republic — ash concrete and gas concrete, wood concrete, slag concrete, and concrete from Roman cement.

Of special importance for the development of the industrialization of building is the theoretical and experimental research, led by

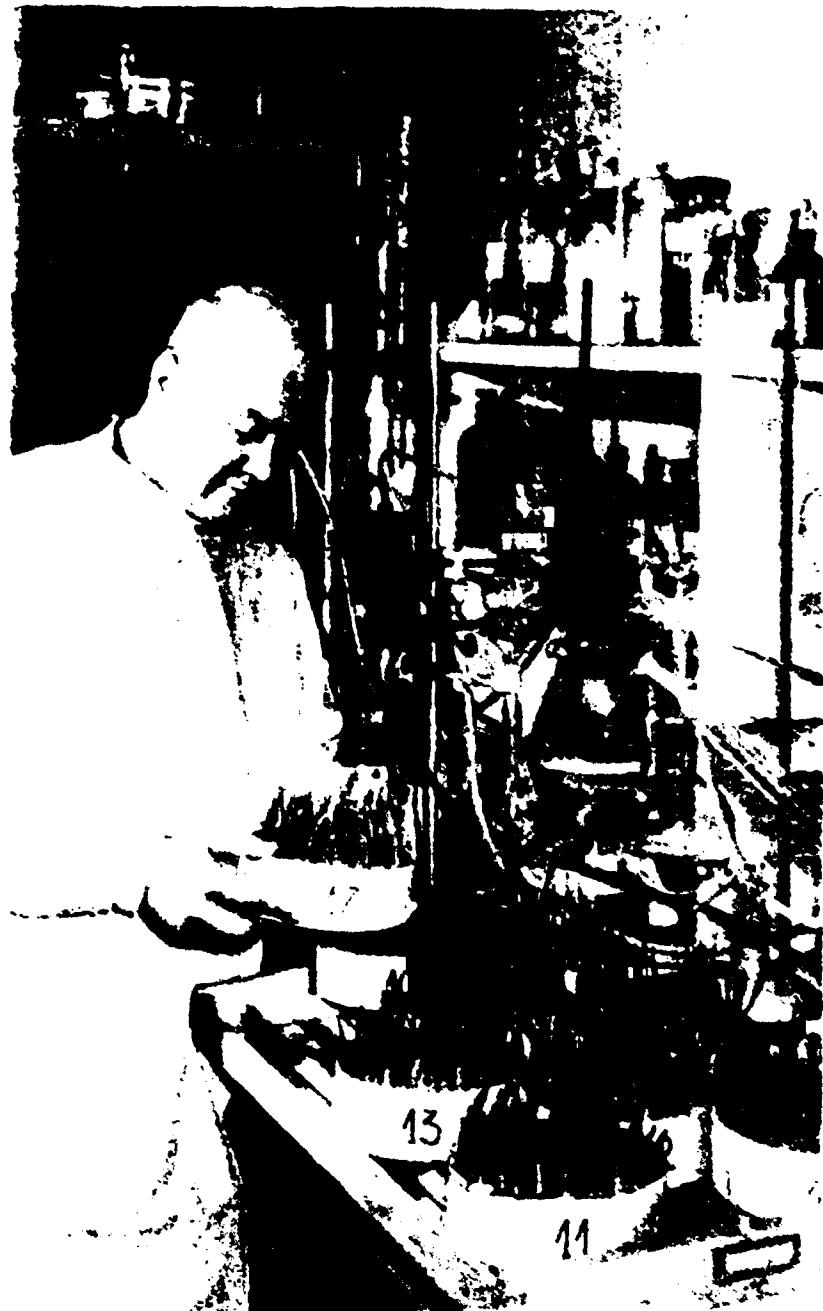


Academician Secretary of the Division of Technical Sciences of the Acad. Sci. Latv. SSR, Corresponding Member of the Academy of Building and Architecture USSR, A. Malmeisters. He is a Member of the Presidium of the Acad. Sci. Latv. SSR and Director of the Institute of Building and Architecture.

Acad. A. Malmeisters, on the rheological properties of concrete under combined loading conditions, and with reference to the length of service of the structures. Methods have been devised and an ultrasonic apparatus designed for the non-destructive investigation of the structure, properties, and strength of concrete structures.

Besides the studies on concrete and ferro-concrete some new methods of town planning and building have been worked out. The history of architecture in the republic is also being studied.

In the first period of work of the Latvian Academy of Sciences most of its scientific institutes were concerned with research in the field of biological, medical, and agricultural sciences. In 1956 three agricultural institutes were transferred to the Ministry of Agriculture of the Latvian SSR. The biological and medical sciences are now represented by the Institute of Biology (set up in 1951) with the Botanic Garden, the Institute of Microbiology, the Institute of Experimental Medicine, and a group of sections of the Institute of Forestry Problems and Wood Chemistry with the Kalsnava Experimental



Academician J. Peive, Corresponding Member Acad. Sci. USSR,  
in his laboratory.

### Forestry Station.

Important scientific and practical results have been obtained from the investigations, led by J. Peive, on the physiological role of microelements in crop nutrition. The role of microelements in raising crop yields has been clarified, the microelement content of the soils of the Latvian SSR has been investigated, and maps of the distribution of mobile forms of microelements (copper, cobalt, zinc, molybdenum, boron, and manganese) in the soils of the republic have been compiled. A portable laboratory for soil analysis and for the determination of fertilizer and lime requirements has been designed. Results of research in this field are being prepared for publication in a monograph "Soil Biochemistry and Microelements" by Acad. J. Peive.

Meadow vegetation (Doctor of Biological Sciences G. Sabardina) has been studied and a geobotanical map has been compiled.

Under the leadership of Academician A. Ozols native-bred varieties of fruit crops are being studied and many promising varieties have been selected for cultivation. Extensive ecological and physiological studies of winterhardiness, the growth and development of nuts in local conditions have also been carried out, and varieties suitable for acclimatization have been selected.

In the Botanical Garden (organized in 1956) questions of the acclimatization and introduction of plants for landscape architecture are being studied and work on breeding ornamental plants has been started.

A general account of the results of research on the fauna and biology of plant pests and measures for their control (Leader -- Doctor of Biological Sciences J. Cincovskis) has been given in the two-volume "Fauna of Latvian SSR".

A study of the biological bases of increasing the productivity of animal and poultry husbandry (leaders -- Acad. J. Bērziņš and Corr. Member Acad. Sci. Latv. SSR A. Valdranis) has led to proposals for using new microelements, vitamins and antibiotic preparations in the feeding of domestic animals. The optimum doses of vitamins, microelements, and antibiotics for different groups of animals have been determined from biological and physiological studies. Methods of enriching mixed fodders with these valuable substances have been developed.

The Institute of Microbiology, directed by Acad. A. Kirchensteins, one of the oldest scientists in Soviet Latvia, is conducting extensive research on the physiology and morphology of microorganisms and viruses, and on the reactions of microorganisms in immunological processes. The interrelationships of the soil microflora with crops are also being studied with the aim of increasing the harvest. In these studies the most modern biochemical and biophysical methods are being widely used and important scientific results have been obtained. Special studies are being devoted to



Association Secretary of the Division of Biological Sciences  
of the Royal Society of Canada, Sec. Univ. 652, A, Ottawa, 2,  
and Director of the Institute of Biology.

The stimulative effect of vitamins on microbial development  
and metabolism. Numerous papers and monographs on this subject  
of wide interest have been published.

For his outstanding services in the field of biological science  
and his many years of teaching and socio-political work the Canadian  
government in 1957 awarded a Kirschbaumische Ring (Order of the  
Socialist Labor).

In the Institute of Experimental Medicine (A. G. M. and  
C. R. M.) research is concentrated on the most important questions of  
the biology of micro-organisms.

resort studies, metabolism and nutrition, tuberculosis, oncology, marginal pathology, and the testing of new medical preparations. In addition, a team in the Institute has been working in recent years on the history of medicine in the Baltic area.

Studies of the mode of action of health-resort and therapeutic physical factors (leader — Prof. P. Perli) have revealed several significant features of the therapeutic action of health-resort factors of scientific and practical importance.

For several years Acad. A. Smidts has been leading research on the physical bases of proper nutrition of human beings in health and disease. The manufacture of a new protein-vitamin preparation has been developed. An all-round study of metabolic disorders in human and animal organisms after exposure to ionizing radiation is also being conducted.

For the development of the industrial synthesis of ascorbic acid Acad. A. Smidts was awarded a Stalin Prize in 1951.

Since 1946 Acad. P. Stradiņš has been leading research on the etiology and pathogenesis of malignant neoplasms and the development of methods of all-round treatment and prophylaxis. His pupils are successfully continuing research on the dynamics of the growth and development of tumor tissue cells in tissue culture, and the pathophysiological and biochemical changes in cancer. They are also investigating new antibiotics and chemotherapeutic agents synthesized by the Institute of Organic Synthesis.

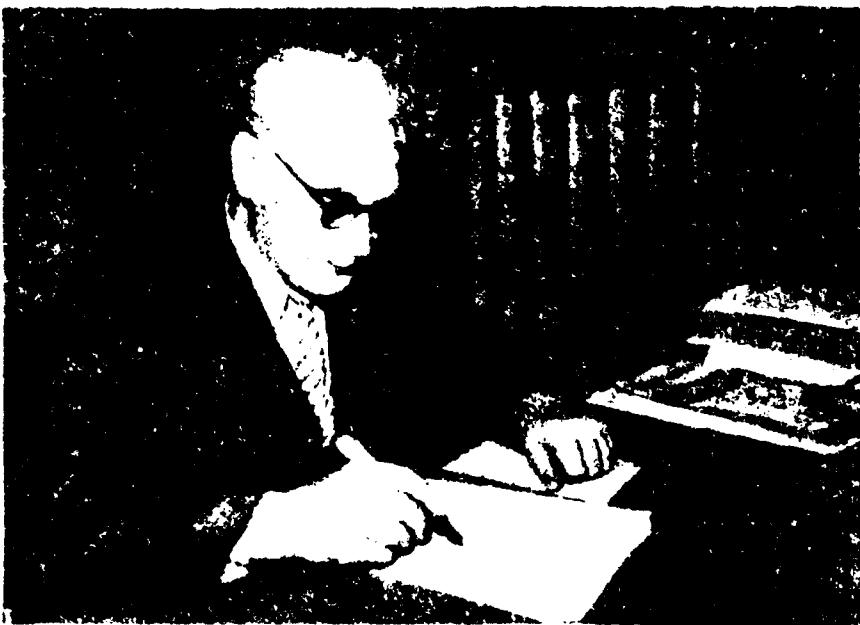
The scope of scientific research on cancer has been greatly expanded, and this problem is one of the most important in the Academy's program.

On the problem of tuberculosis (leader — Doctor of Medical Sciences N. Stoligov) a number of studies of pulmonary and extra-pulmonary tuberculosis have been carried out. A clinical assessment of the effect of several preparations of paraaminosalicylic acid has been made, and the antiinflammatory action of PAS, Ethiviaside, and Tubazid, which have been adopted for the treatment of tuberculosis, has been shown. New methods of surgical treatment of tuberculosis of the joints and lungs have been devised.

In recent years several questions on rheumatism and diseases of the cardiovascular system have been tackled. One of the main topics in this field is a study of the role of the connective tissue and endocrine system in the pathogenesis of cardiovascular diseases.

P. Čorke is heading research in the field of morphology and physiology of animals and man in health and disease. Of special importance in this direction are the studies of the morphological changes in radiation sickness. Of great importance also are the investigations of the role of the peripheral and central nervous system in the control of vascular reactions.

The formation of the Latvian Soviet Socialist Republic has created the most favorable conditions for the flourishing of the



Acad. K. Strazdiņš, Academician Secretary of the Division of Social Sciences, Member of Presidium of Academy, Director of Institute of History.

social sciences. A real, scientific, Marxist-Leninist elucidation of questions of the economics and culture of the Latvian people has become possible.

The Academy of Sciences has set up a network of research institutes (Institute of Economics, Institute of History, Institute of Language and Literature with Literary Museum, the Central Library), which are working on the most important problems of the economics, History, language, literature, and folklore of the Latvian people, and of Latvian archaeology. Besides directing the institutes, the Division of Social Sciences also coordinates the scientific work of all the scientific and advanced educational institutes of the republic.

Economic studies form an important part of the research in the field of the social sciences. Special attention is being given to industrial and transport problems, research on fuel resources, municipal economy, and the all-round development of the national economy of the republic. Acad. F. Deglavs, Acad. N. Kovaļevskis, and other scientific workers have produced several important publications and monographs on these questions.

The scientists of our Academy have also given great assistance in the task of raising the level of agricultural production. They have published the greatest number of individual monographs, practical manuals, and scientific papers.

In recent years a study of Soviet legal regulations, the legal relations of state organs, and other questions of Soviet law, has commenced.

Acad. P. Väleskalns is now leading research on the development of social thought. This research is concerned with problems of philosophy, esthetics, and ethics.

The efforts of our historians have been directed primarily towards the creation of a systematic Marxist course of history of the Latvian SSR. This work was completed with the publication in Latvian and Russian of a concise course of history of the Latvian SSR under the editorship of Acad. K. Strazdiņš, and a comprehensive systematic course "History of the Latvian SSR" in three volumes, under the editorship of J. Zutis, J. Krastins, K. Strazdiņš and A. Drizulīc.

The publications and monographs of our historians on the most important historical problems constitute a fundamental contribution to the historical science of the peoples of the USSR. For his monograph "The Ostsee Question in the XVIIIth Century" Acad. J. Zutis was awarded a Stalin Prize in 1950, and Acad. J. Krastins received a similar award in 1952 for his monograph "The 1905 Revolution in Latvia". In 1957 the historian M. Stepermanis was awarded a Republican Prize of the Latvian SSR for his work "The Peasant Revolts in Liefland in 1750-1784".

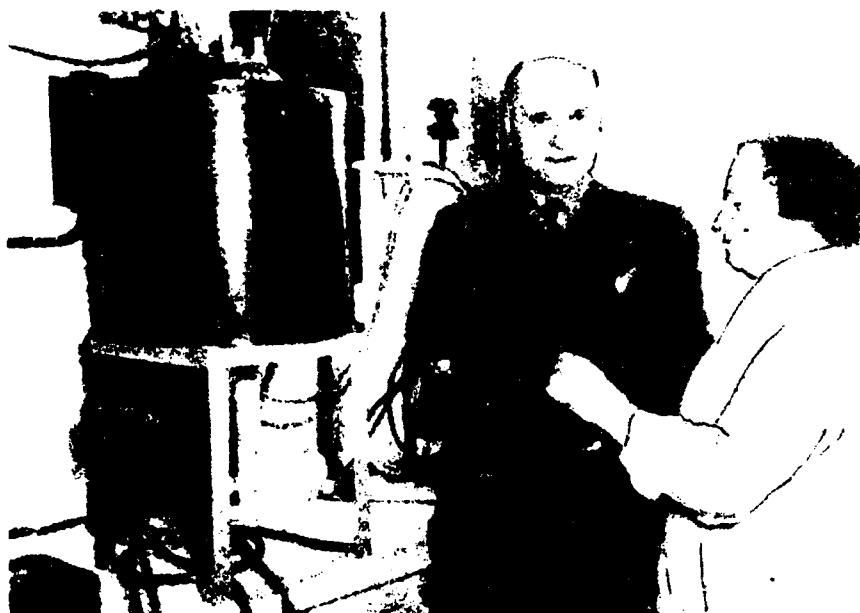
The Institute of History is also making good progress with research on the archaeology and ethnography of the Latvian SSR. Expeditions have provided a wealth of material on the history of the material culture and life of the Latvian people and the changes occurring during the period of construction of socialism and communism.

Under the directorship of Acad. J. Endzelīns the Institute of Language and Literature has carried out a vast amount of work on the theory of the Latvian language. For his "Grammar of the Lettish Language" Acad. J. Endzelīns was awarded a Lenin Prize in 1956, and in 1957 he received a Republican Prize of the Latvian SSR for his monograph "Toponymic Names of the Latvian SSR".

Considerable attention is being devoted to the collection and publication of material representative of the national culture. More than three million folklore units have been collected and some have been published (Lettish tales, Lettish riddles, selected Lettish National Songs, etc.). On the subject of the development of Latvian national culture we should note that studies of the history of Lettish literature constitute a considerable part of the research in the social sciences. Among these studies we can single out the "Lettish Literature" of Acad. A. Upitis, the monograph on the work of the

national writer J. Rainis by the Director of the Institute E. Sokols, the work of Candidate of Philological Sciences J. Kalnīns "In the World of Satire" (awarded a Republican Prize of the Latvian SSR in 1957), the "Repertoire of the Latvian Theatre" by Candidate of Philological Sciences K. Kundzīps, the study of the work of Blaumans by Candidate of Philological Sciences A. Vilsons, and others. Our specialists in literature are making good progress with the six-volume "History of Latvian Literature", four volumes of which have already been published.

The Central Library, founded in 1946, has grown into a huge cultural institution. The library stock numbers more than 1,200,000 volumes of scientific literature published in the Soviet Union, the peoples democracies, and in capitalist countries. The library exchanges scientific literature with more than 200 libraries in 34 countries.



Academician Secretary of the Division of Chemical Sciences, Member of the Presidium of the Acad. Sci. Latv. SSR, A. Kalnīns. He is Director of the Institute of Forestry Problems and Wood Chemistry. Beside him stands V. Sergejeva, Candidate of Chemical Sciences and Deputy Director of the Institute of Forestry Problems and Wood Chemistry.

The extensive development of the social sciences in the Latvian

SSR is one of the clear indications of the triumph of Marxist-Leninist ideas, and will ensure the future flourishing of every aspect of the socialist culture of the Latvian people.

Our institutes also participate daily in the practical work for the development of the national economy, culture, and health of the republic. However, in this short review we cannot mention all the specific contributions which have been adopted in the national economy and which have led to considerable saving.

An index of the amount of work done by the institutes is the volume of printed work. During these years the Academy Press has published 750 titles with a total number of more than 1,700,000 copies and more than 150 titles have been published outside the Press.

A great amount of valuable work on the publication of the works of research institutes and of the Academy as a whole has been done by the Latvian Academy of Sciences Press (Director -- A. Brissens, Editor-in-Chief -- A. Zaks) and the editorial office of the journal "Latvijas PSR Zinatnu Akademijas Vestis" Editor-in-Chief -- L. Graudins, Corresponding Member of the Acad. Sci. Latv. SSR). The Academy Press has published many valuable books by the scientists of Soviet Latvia. From 1947 to the end of June 1960 the editorial office of the journal published more than 156 volumes of "Latvijas PSR Zinatnu Akademijas Vestis".

The resolutions of the 20th and 21st Congresses of the C.P.S.U. were of decisive importance for the subsequent development of the scientific work of the Academy. The Academy was set the task of securing an even more rapid development of all branches of science during the seven-year plan, and of conducting the important theoretical studies required to ensure the future scientific and technical progress in the national economy.

In view of this our scientific resources and means have been concentrated on the most important practical and theoretical lines of research. At the same time, our institutes have devoted more attention to the solution of one of the main problems of securing the fulfilment of the seven-year plan for the national economy -- the problem of the more rapid introduction of the results of scientific and engineering research into the national economy.

These have been the main features of the program of scientific and administrational work of the Academy of Sciences during recent years. The subjects of research of several institutes have been altered to conform with the resolutions of the June Plenum of the C.C. of the C.P.S.U. Research directed towards a solution of the most important problems of development of new branches of industry in the republic, and the creation of a sound scientific foundation for technical progress, has been intensified.

At the same time, several administrative measures have been

taken to consolidate the network of scientific institutions, to set up new laboratories (reactor laboratory, semiconductor laboratory, gas heat engineering laboratory, laboratory for concrete rheology). The Institute of Electronics and Computer Technique was recently organized (1960). In the current year the Institute of Mechanical Engineering is to be transformed into an Institute of Mechanics and Automation.

The Academy will be strengthened in scientific staff by an increase in the intake of research students, and by the assignment of our scientific workers for a period of training to the institutes of the Academy of Sciences of the Union. A greater number of highly-qualified personnel are being trained. In the forthcoming years about 20 persons will present their doctoral dissertations for defense. Recent elections have added a new group of Academicians and Corresponding Members to our Academy.

The Academy of Sciences of the Latvian SSR has crossed the threshold of the 20th anniversary of the reestablishment of Soviet power in Latvia with great scientific and practical achievements. The Academy is a strong detachment of advanced Soviet science in the republic and is capable of tackling the still more difficult tasks which the Party and Government will put forward.

The general prospective plan of scientific development in our republic has been worked out and approved. We need only mention that this plan proposes to create 14 new scientific research institutes. By 1980 the Academy will comprise more than 7000 persons. A great variety of laboratory buildings, experimental workshops, and experimental apparatus, will be constructed.

The creation and growth of our Academy clearly shows that only under socialism and communism is science free and has real opportunities for all-round, planned development. Splendid prospects confront the scientists of Soviet Latvia, and we will joyfully devote our efforts to the construction of the bright future of mankind -- communism.

THE FLOURISHING OF GENERAL SCIENCES IN THE  
LATVIAN SSR

by K. Strazdyn'

Pages 25-38

Before the forming of the Latvian Soviet Socialist Republic the development of the general sciences on Marxist-Leninist lines was impossible.

Immediately before the great October socialist revolution, the historians, economists and literary "schools" of the Ostsee Germans propagandized a false theory that the campaigns of the "knight crusaders" of the Baltic margins, their brutal exploitation of the Latvians and Estonians and their plunder and loot of the local population constituted a "bringing of culture", a great "cultural mission" to the land of "barbarians". In the 20th century some of them became propagandists of the reactionary and aggressive ideas of Fascism and the expansionist tendencies of the German imperialists.

These ideologists, strengthened by the Latvian bourgeoisie, half-heartedly attacked the rule of the German barons and burghers, and, looking timidly around, around, criticized the "theories" of their ideological representatives from a position of narrow class interest, and then proceeded to agree with them. Russian bourgeois historians and economists who were concerned with Baltic questions obscured the separatist conceptions of the Baltic German ideologists and contributed much that was of value to several questions on the domestic and general life of the Baltic peoples. But their works gained little attention in those countries and, of course, there was no

Marxist elucidation of the questions in their work.

In the period of dictatorship by the Latvian nationalist bourgeoisie (1920-1940) the question of the existence of any more or less serious bourgeois science hardly arises; one can only wonder at its poverty and worthlessness. The so-called "academic world" was led by professors of the Latvian University, the bourgeois nationalists A. Tentelis, A. Shvabje, F. Zalitis and other similar people, who denied the existence of any objective laws in social development and maintained that the process of human historical development was "irrational" and "unknowable", and that it was determined, as they put it, by "higher will" and "nationalism". These "academics" became lackeys of the nationalist bourgeoisie; they propagated and praised the fascist regime, racism, bourgeois nationalism and the falsification of history; they slandered the Soviet Union, and, entrenching themselves in the camp of enemies of the people, they collaborated with the fascist German aggressors in the years of the great patriotic war. Some of these "historians", "economists", "philosophers", "literary men" and other "academics" are still carrying on their dirty work amongst Latvian emigrants in the United States, West Germany, Sweden and other capitalist countries.

Here we should note that the Latvian social democrats also collaborated with the Latvian nationalist bourgeoisie in propagating their inhuman "scientific" conceptions and their political aims. The descendants of these enemies of socialism are even now propagandizing from overseas the aggressive nationalist ideas of the reactionary imperialist bourgeoisie, and they dream of the re-establishment of capitalism in Latvia. In their program and in their explanation of it they openly state that their party has "disproved" the postulates of Marxism, that they have "discarded the Marxist philosophy" and that their party is an "anti-communist party" which has as one of its chief aims "the struggle against communist ideas".

Of course there developed in bourgeois Latvia, alongside the ruling bourgeois culture, elements of democratic and socialist culture, the culture of the toiling and exploited mass of the people. But under conditions of dictatorship by the reactionary nationalist bourgeoisie these elements could not achieve any noticeable results in the sphere of general sciences. Isolated works, written from the point of view of revolutionary democracy and penetrating through the obstacles of the censor, for example part of the works of A. Upit on questions of literary

criticism, the history of literature and other subjects, could not change the character of the general situation.

The first attempts to give a Marxist explanation of the problems of economics and history in Latvia appeared at the end of the 19th century and the beginning of the 20th century, when the Latvian working class began to take form and to struggle for its emancipation. These attempts were the works of Fritz Rozin-Azis, in particular his work "Pages from the History of the Latvian Peasantry"; the works of Pyotr Stuchka ("Political Freedom", "Thoughts on the Agrarian Problem", "Labor and Land", etc.); the textbook "A History of Latvia" by Karl Lander; several of the works of Yan Tanson-Brun, Andrey Upit and others. These works, in spite of their shortcomings and occasional erroneous statements, constituted in general a valuable contribution to the depository of Marxist social science.

In the period of dictatorship by the nationalist bourgeoisie in Latvia (1920-1940), Marxist social thought was further developed by that section of Party and scientific workers which was outside Latvia, in the Soviet Union. On the initiative of P. Stuchka, Ya. Berzin-Viater, P. Daugve and others in Moscow a "Commission on the History of Latvia" was set up. The Commission published various works of P. Stuchka ("Five months of Soviet Latvia"), three collections of documents and material entitled "The Proletarian Revolution in Latvia", two collections of documents and memoirs entitled "The 1905-1907 Revolution in Latvia", five collections of essays, memoirs and material on the history of the Latvian rifle regiments and numerous other works. Pyotr Stuchka translated and published the first volume of "Capital" by K. Marx. Numerous works of V. I. Lenin, F. Engels and K. Marx were also translated into the Latvian language. The "Commission on the History of the Communist Party in Latvia" prepared and published a collection of articles and material entitled "25 Years of the Latvian Communist Party" which included the resolutions of congresses and conferences, and also the most important decisions of the Central Committee of the Latvian Communist Party. The Moscow publishing house "Spartak" also published various works on the agrarian question and on many other economic, historical and political problems of Latvia.

The formation of the Latvian Soviet Socialist Republic created favorable conditions for the development of social sciences in Latvia. Workers of higher educational establishments and scientific research institutes gained access to necessary documents and materials in archives.



Academician AS Latv. SSR, Corr.-member AS USSR  
Ya. Eutis, Stalin prizewinner.



Academician AS Latv. SSR Ya. Krastin', Stalin  
prizewinner.

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and from other sources. State and public organizations did all they could to support and encourage scientific research work, setting specific research tasks. A really scientific Marxist-leninist approach to social problems thus became possible, and research work enjoyed material support both by a guarantee of the necessary financial means, and by the formation of teams of research workers and a whole network of research establishments.

The creation in 1946 of the Latvian S.S.R. Academy of Sciences was of particular positive significance in the development of social sciences within the Republic. There are at present in the Academy three research institutes for the social sciences: the Institute of Economics, the Institute of History and the Institute of Language and Literature, and also the Literary Museum and the Fundamental Library.

It is worthy of note that in all the research establishments of the Academy of Sciences of the Latvian S.S.R., including the Fundamental Library, there are in the sphere of the social sciences over 400 scientific and technical workers, and the annual budget of all these establishments is about eight million roubles. All this goes to show the enormous interest of the Soviet Government in the development of scientific research in the Republic. On the staff of the Institutes of social science of the Academy of Sciences of the Latvian S.S.R. there are 15 academicians, correspondent members, doctors of science and professors, and 66 graduates in science. More than 10 scientific workers (graduates in science) are working on their doctoral theses, which will be completed in the next few years. In all the Institutes there are postgraduate schools where several workers study and prepare for the qualification of "candidate in sciences".

In our brief outline of the state of the social sciences before the formation of Soviet Latvia it is clear that the Institutes of the social science department of the Latvian S.S.R. Academy of Sciences, founded in 1946, were faced with difficult tasks. It was necessary to collect and study the enormous amount of archive and other material, to evaluate the entire "inheritance" from the Marxist-Leninist point of view, to clear away the unscientific and harmful "theories", concepts and falsifications of the bourgeois academies and to create as quickly as possible scientific works on the most important developments and problems of social science in conformity with the needs of the Republic. The task of selection and training of research teams was also difficult and complicated.

It is not very long since the formation of the Institutes of social science in the Academy of Sciences of the Latvian S.S.R., but they have already carried out significant work and already have to their credit some important achievements in the development of the social sciences.

In the Institute of Economics, the Section of political economy (the "general economic" section) has done much work on complex problems connected with the distribution of productive forces within the Republic. In this work problems of transport, fuel resources, communal management, labor resources and other problems play an important part. In connection with the project for building a hydro-electric station on the river Daugava and joining the river with the Dniepr, the Institute of Economics played an active part in the preparation of projects for the solution of this problem, and worked out the changes in the distribution of productive forces which would take place as a result of this project. Members of the scientific staff of the Institute, A. Rudzit, L. Starodubskiy, N. Nechetnyy, V. Varverye, A. Rozenberg, K. Nikolayeva, Z. Gulyayeva, R. Vayvod and others produced some valuable suggestions and material on related problems. The results of this work are set out in a four-volume work which has been highly praised both in Republic and Union establishments taking part in the working out of these problems. The Section carried out work on problems of transport and the creation of a balanced distribution of energy. Questions concerned with the improvement of the material welfare of the workers of the Republic were also studied, K. Graudin, correspondent member of the Academy of Sciences of the Latvian S.S.R., wrote several works on the economics of product and transport in Soviet Latvia, and also on cultural themes. These works are as follows: "An outline of Soviet Latvia", "Inventors of the steam locomotive", "Inventors of communications" and a monograph "Latvia in the national economy of the U.S.S.R.". A. Rudzit, a scientific worker of the Section, prepared a monograph on "The ports of the Latvian S.S.R., their place and significance in the national economy of the U.S.S.R.", and N. Nechetnyy a monograph "Problems of the balance of fuel and energy in the Latvian S.S.R.". Two final monographs were presented as theses for the degree of Candidate in economic sciences. Academician F. Deglav has been working on the conformity to law and the peculiarities of the development of socialism in the Latvian S.S.R., and has

prepared a monograph "The victory of socialism in the Latvian S.S.R." In the last few years the Section has been faced with the most important and complicated tasks connected with the reorganization of production management and the creation of future plans - the study of the relationships between economic regions, the creation of a future balance of natural and labor resources, the determining of the future path for further development and growth of the national economy, and so forth.

The Section of Production Economics has paid great attention to problems of future rational development of industry in the Republic, economy of materials and labor costs, raising the productivity of labor, the reduction of production costs and the rationalization of labor organization, and the use of national resources. Scientific workers V. Leych and V. Tumshevits prepared a monograph "The economic regime for light industry in the Latvian S.S.R.", and Z. Kozlova, K. Nikolayeva and M. Purin prepared a monograph "The economic regime and organization of internal factory budgets in the metal-working undertakings of the Latvian S.S.R.". Important research works were also produced by: R. Shultz on "Specialization and concentration in the production of instruments and machinery in the Latvian S.S.R."; R. Vayvod "Reserves of the Industry of constructional astrigents in the Latvian S.S.R., and development prospects"; V. Deych "Specialization and co-operation in the textile industry of the Latvian S.S.R." and K. Uksov "Ways of raising the productivity of labor in the production of industrial goods in the Latvian S.S.R." All the above mentioned works were of considerable significance in improving the work of industrial undertakings in the Republic. The industrial Section is also working on a number of other themes and problems which will help producers in rationalizing the process of production, in raising labor productivity, and in lowering costs in the various sectors of industry in the Republic.

The Agrarian Section of the Institute of Economics has rendered great assistance to the Ministry of Agriculture and to local staff in raising the level of agricultural production. The results of agrarian reorganization under the Soviets have been gathered together and set out in an important work (a doctoral thesis) by a member of staff of the Section, S. Udachin, "Agrarian Reform in Soviet Latvia". During the early years of the Institute, scientific worker A. Motrov prepared a brochure "The Organization of Labor in Peasant Agriculture, Machine and Horse-hiring Centers and Tractor Stations".



Corr.-member AS Latv. SSR, Acad.-secretary AS  
Latv. SSR, Hero of the Soviet Union V. Samson



Corr.-member AS Latv. SSR A. Drizulis, Deputy  
Director of the Institute of History AS Latv. SSR.

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The staff of the Agrarian Section rendered great assistance to workers in Agriculture, taking active part in the organization and running of collective production on the spot in the period of all-out collectivization, and later in the administrative and organizational improvement of collective farms. In order to improve the organization of collective production, the section made a number of model production plans and proposals for the future based on the experience of the best collective farms (the work of I. Zemniyek, V. Sitchikhin and others). On the problems of the most advanced section of agricultural economy in the Latvian S.S.R. (stockbreeding) a monograph was prepared by I. Zemniyek, of the Agrarian Section, entitled "Communal Cattle Breeding and the Fodder Basis of the Latvian Collective Farms". I. Rudyevich wrote a monograph "The Use, Organization and Remuneration of Labor in the Cattle-Raising Collectives of the Latvian S.S.R.".

The staff of the Agrarian Section carried out some significant work on problems of specialization and the distribution of agricultural production in the Republic. As a result of this work a collective document was published "Measures for the Organization of a Rational System of Agriculture in the Zones of Vidzem, Zemgal, Kurzem and Latgal".

The Agrarian Section has paid much attention to the question of the mechanization of Agriculture. P. Gulyan, scientific worker in the Section, wrote a monograph "The Mechanization of Crop Farming and its Economic Effectiveness in the collective farms of the Latvian S.S.R" and A. Braksh wrote a monograph on "The mechanization of Cattle-Breeding Processes, its Effectiveness and future prospects in the Collective Farms of the Latvian S.S.R."

K. Tsipe produced a brochure on the question of remuneration of labor in collective farms entitled "Survey of the Collective Farms of the Latvian S.S.R. and Improvements in Labor Remuneration", and R. Soms produced a brochure on the question of production costs entitled "An analysis of the cost of production in the collective farms of the Latvian S.S.R.".

Under the leadership of Academician M. Kedek, the Economic Geography Section commenced preparation of a course "The Geography of the Latvian S.S.R." in the early days of its activity, but this work was temporarily interrupted when the staff of the Section were transferred to work on the problems of regionalization and the preparation of the course "An Economic Geography of the Latvian S.S.R." The course "The Geography of the Latvian S.S.R." was then

prepared by one of the staff of the Section, V. Furin, and two lecturers of the Latvian State University, A. Kolotiyevskiy and A. Yaunputnyc'. As a result of a great amount of collective work by the staff of the Section there appeared the course "The Latvian S.S.R. An outline of economic geography," edited by Ya. Bumber and P. Alampivars. Workers of the Section prepared "A statistical atlas of the Latvian S.S.R." containing diagrams, schematic maps and other graphic representations. The Section also paid considerable attention to regionalization and to the preparation of economic maps for use in educational establishments and an agricultural atlas. Brochures were also prepared which gave the economic characteristics of the regions of the Latvian S.S.R.

The section for the history of economic thought and the history of national economy has carried out important work in clearing up the unscientific conceptions and falsifications of the bourgeois economists, and has produced several works which give a Marxist-Leninist exposition of the development of economic thought and the national economy in Latvia. In connection with this, we might mention the following works by members of the scientific staff of the Section: A. Veynberg "The impoverishment of the proletariat in bourgeois Latvia"; L. Starodubskiy "The decay of factory industry in bourgeois Latvia" and his "Statistics of bourgeois Latvia in the service of reaction"; a collective work (a collection of articles) on questions of the development of economic thought in the period from the middle of the 19th century to 1940; I. Kirtovskiy "The development of Latvian economic thought in the '30's and '90's of the 19th century" (this work deals mainly with an exposition of the economic views of the revolutionaries of the "new stream" - P. Stuchka, F. Rozin and E. Veydenbaum); Ya. Kalnin' "The economic platform of the Latvian Communist Party in the years 1920-1940". The staff of the Section have prepared and published the selected works of Academician F. Deglav in two volumes.

The legal Section of the Institute of Economics, which was created last year, has commenced studies on questions of legal standards in the soviets, the legal relationships between State organs, the rights and duties of members of agricultural cartels, the legal relations of inter-collective farm organizations and other questions of soviet legality. The section is also taking part in working out and correcting the legal codices of the Republic.

A section for the development of social thought has also been recently established within the Institute of



R. Turcins - Corr.-member AS Latv. SSK, Director of the Institute of Economics AS Latv. SSK.



Corr.-member AS Latv. SSK Ya. Bumber.



Academician J. Anselins, Corresponding Member of the Acad.  
Sci. U.S.S.R., Lenin Prize Winner.

Economics, under the direction of Academician P. Valeskals. The purpose of this section is the study of problems of philosophy, aesthetics and ethics. Members of this section - Academician P. Valeskals and others - have done active work on the study of the development of philosophical thought in Latvia in the period before the great October socialist revolution and have taken part in writing collective works on the history of philosophy produced by the Institute of Philosophy of the Academy of Sciences of the U.S.S.R. Academician P. Valeskals has published a monograph "The revolutionary democrat P. Balod".

Much work on the organization and direction of the Institute of Economics has been carried out by ex-directors of the Institute Academician N. Kovalyevskiy, Academician F. Deglav and correspondent member Ya. Bumber. At present the Institute of Economics is under the directorship of correspondent member Ya. Turchins.

As is clear from the above, the Institute of Economics concentrates on problems connected with the building of socialism and communism, and has as its aim the furtherance of this work by collaboration. In addition to this the Institute employs all its scientific and practical resources in widespread propaganda of the economic theories of Marxist-Leninism and also takes part in the communist upbringing of workers.

The efforts of the Institute of History were directed above all towards the creation of a systematic course in the history of the Latvian S.S.R., since this was demanded by educational establishments, soviet and Party activists and also by a wide circle of readers. It was necessary to give a Marxist-Leninist account of the history of the Latvian people and to clear up the falsifications of the Baltic German feudal landlords and the Latvian nationalist bourgeoisie. The Institute of History has already completed this work. A one-volume condensed course entitled "A history of the Latvian S.S.R." has been published under the editorship of the director of the Institute, Academician K. Strazdyn', together with a full and systematic course in three volumes of 170 pages. These works are in both Latvian and Russian. The first volume of the full edition (edited by Academician Ya. Zutis) contains the history of Latvia from ancient times until the epoch of capitalism, the second volume (edited by Academician Ya. Krastyn') describes the period of capitalism from 1861-1917, and the third volume (edited by Academician K. Strazdyn') contains the history of the Latvian S.S.R. from the great October socialist revolution up to the present day. The

main authors of these works were the above mentioned editors and candidates of historical science E. Andersone, T. Draudin', A. Drizulis, T. Zeyd, M. Steperman and others.

The Institute of History has also published a number of collective works - collected articles of a thematic nature: "The bourgeois nationalists - their falsifications of history in Latvia", "Aggression of American and West European imperialists in Latvia", "The struggle for Soviet rule in Latvia", "The great October socialist revolution and foreign armed intervention in Latvia", "Against the idealism of the young Latvian movement". In addition to this the Institute of History has commenced publication of a periodical of collected articles under the general title "Problems of History". Three collections have already been printed.

The Institute of History has also paid considerable attention to the publication of material, documents and other sources of the history of Latvia. Thus, for example, the Institute has printed "The Manaseyn investigation" (an account by senator Manaseyn of an investigation carried out by him in the Lифlyanskiy and Kurlyandskiy regions in 1382 and 1383); a collection of documents "The 1905-1907 revolution in Latvia"; a collection of documents "The October revolution in Latvia"; a two-volumed collection of documents "Soviet Latvia in 1919"; a collection of documents and material "The Latvian artillery in the struggle for soviet rule". Under the direction of scientific worker A. Germanis, staff of the Institute are engaged in work on the compilation of a bibliography of the history of the Latvian S.S.R., and considerable amounts of archive material on the history of Latvia have been collected in the library of the Institute under the direction of the chief librarian, G. Berenta.

A large part of the Institute's work has been taken up with the writing of monographs on the fundamental problems of the history of Latvia. The most important of those already published are as follows: Ya. Zutis "The Ostsee question in the 18th century" (in the Russian and Latvian languages) and "An outline of the Historiography of Latvia"; Ya. Kraustyn' "The 1905-1907 revolution in Latvia"; M. Steperman "Peasant uprisings in Vidzem, 1750-1784"; B. Brezhgo "The Latgalian peasantry after the change in the law of serfdom (1861-1917)" and "An outline of the history of the peasant movement in Latgalia, 1577-1907"; T. Zeyd "Feudalism in Livonia"; B. Vilks "The formation of the industrial proletariat in Latvia in the second half of the 19th century"; T. Draudin' "The landless Latvians in the

struggle for land and the rule of the soviets, 1917-1919", "The campaigns of the Latvian rifle divisions in the days of October and in the years of the civil war"; A. Spreslis "Working class movements in bourgeois Latvia in the years of the world economic crisis (1929-1933)"; Yu. Nyetyesin "The working class movement in Riga in the period of the Stolypin reaction"; M. Kozin "Peasant movements in Latvia in the 60's of the 19th century"; A. Drizulis "Latvia under the yoke of fascism (1934-1940); V. Savchenko "The historical links between the Latvian and Russian peoples", and other monographs.

The following monographs are already completed and ready for printing: A. Miyerin' "Agrarian relations and the state of the peasantry in Kurland in the 60's and 80's of the 19th century"; M. Kozin "Agrarian relations in the Lifyandskiy region in the 60's and 80's of the 19th century"; V. Doroshenko "An outline of the history of agrarian Latvia in the period of decay of the landlord economy"; G. Stroda "The development of agricultural economy in Latvia in the period of decay of the feudal landowning class (from the end of the 18th century to the first half of the 19th century); D. Liyepinya "The peasantry of the Rizhskiy patrimonial district from the 13th to the 19th centuries"; A. Stubav "The site of the town and village of Kenteskalns".

The Section of Archaeology of the Institute of History has done some good work under the direction of candidate in historical sciences T. Zeyd, and in recent years under A. Stubav. The section has carried out annual archaeological expeditions and excavations of burial places, old towns and other ancient settlements. Special attention has been devoted to the investigation of that part of Latvian territory which lies along the border with the R.S.F.S.R., in order to throw light on the economic and cultural connections between the Latvian and the Russian peoples and to clear up certain questions of ethnogenesis. The largest excavations in this area were carried out in the Ludzenskiy Region (the Nyukshinskiy burial places and others) and the Krustpilsskiy Region (the site of Asotye). Candidate in historical sciences E. Shnorye was in charge of the excavations. The progress and results of these excavations are documented in volumes 1 and 2 of a series of publications "Material and research on the archaeology of the Latvian S.S.R." (volume 1 - "The Nyukshinskiy burial place", volume 2 - "The site of Asotye"). Under the direction of the Head of the archaeological section, A. Stubav, widespread excavations have been carried out in the territory of the town site of Kenteskalns (in the Orgye Region),

and also in the territory of the site of Turayd. The excavations in the Dobylekiy Region on the Tervetye site under the direction of scientific worker E. Brivkalnye are worthy of note. The above mentioned excavation and others have yielded rich and hitherto unknown material on the development of the economy and culture of the Latvian tribes and of their connections with Slavonic tribes. In the Section, a special laboratory has been set up to restore and preserve the objects found in excavations. A photographic laboratory has also been established. The archaeologists of the section are collaborating with paleobotanists, paleo-zoologists, metallographists, geologists, researchers into soil and wood and other experts, and also with archaeologists from the other republics. The staff of the Section has prepared and will shortly publish a series of important works explaining the results of the archaeological expeditions in the territory of the Latvian S.S.R. Amongst them will be monographs on the excavations of the sites of Kenteskalns, Tervetye, etc.

The Ethnographic Section of the Institute has done much work on studying the material culture and lore of the Latvian people, paying especial attention to an explanation of the changes which took place in the material culture and way of life of the socialist nation in the period of construction of socialism and communism. Candidate in historical sciences M. Steperman is the director of the section. The section makes annual expeditions to various regions of the Republic, and has gathered a large amount of valuable ethnographic material. The staff of the section have also prepared and published some valuable written work, for example: A. Krastins - "Peasant housing in Vidzem in the period of decay of the landlord economy and the growth of capitalism"; S. Tsimerman - "The way of life of the agricultural workers of Kurzem and Zemgal in the second half of the 19th century"; the collection of articles "Archaeology and ethnography" volume 1; (volumes 2 and 3 are prepared and are being printed) and other works. The section has also prepared the following works: "The Glubenskiy Region" (material and results of the work of expeditions in that region); "Ziyemyelvidzemye" (material and results of expeditions in the Valskiy and Limbajskiy Regions); M. Slava - "The clothing of the Latvian peasantry in the period of decay of the landlord economy". The Ethnographic Section collaborates with local regional museums and ethnographists of neighboring Republics, and also takes part in the combined Baltic expeditions organized by the Institute of Ethnography of the Academy of Sciences of the U.S.S.R. In

these expeditions, ethnographers from Byelorussia, Lithuania, Latvia and Estonia all take part.

In addition to the above mentioned work, the scientific staff of all sections of the Institute of History publish many brochures and articles both in the Republican and Union press.

At present the Institute of History is working on the preparation of many large works. Of these, the most important are: a four-volume "History of the national economy of Latvia (the Institute of Economics is also taking part in the preparation); a three-volume "History of the Latvian rifle regiments"; "A history of the city of Riga"; "The struggle of the Latvian workers against the German fascist aggressors in the years of the great war for the fatherland"; "A history of the culture of the Latvian people"; "A history of the Latvian peasantry"; a general ethnographical work "The Latvians". The following are also planned: "A history of the Latvian proletariat", "A history of the cities of Latvia", and other collective and monographical works. The Archaeological Section has resolved in the next few years to carry out widespread excavations of town and burial sites along the banks of the river Daugava in connection with the construction there of a large new hydro-electric station.

In the Institute of Language and Literature, the Section of Dialectology and History of Language, directed by candidate in philosophical sciences E. Shmitye, has done a great deal of work in the collection of material on topography, dialects and local patois. The first volume of the work by Academician Ya. Endzelins "Toponymics in the Latvian S.S.R." has already been printed, and the next volume is being prepared for print. The Section is working on the editing of a collection of works by Academician Ya. Endzelins. Work is in progress on an "Atlas of the dialects of the Latvian S.S.R." and the publication of the multivolume "Regional dictionary".

In the Dictionary Section which is directed by Academician Ya. Endzelins, work is being carried out on the preparation of a six-volume publication "An explanatory dictionary of the modern Latvian literary language". The Section took part in preparation of the two-volume "Russian-Latvian dictionary" which has appeared in print.

The Grammar Section, directed by the Head of the Section R. Grabis, has completed the publication of a two-volume "Grammar of the modern Latvian literary language" - a textbook for establishments of higher education. The

staff of the Section are working on the preparation of a general work on the history of the Latvian language. The Section plays an active part in working out the terminology of the Latvian language.

In the Institute of Language and Literature, great attention has been paid to the collection and publication of material on national literary works. In the archives of the Folklore Section (directed by Candidate in philosophical sciences E. Kokar) up to 3 million separate works of folklore are collected (folk songs, tales, proverbs etc.). The Section has already published the following: "Latvian tales" in four volumes, edited by Ya. Niyedrye; A. Antsel-anye - "Latvian conundrums"; "Selected Latvian folk songs" in three volumes; E. Kokar - "Latvian proverbs and expressions"; Ya. Vitolins - "Revolutionary songs"; a series of collections of Latvian folklore material for children: Ya. Vitolin' - collections of Latvian folk tunes and other editions of material of folk literature. The Folklore Section has begun the preparation of an academic edition of Latvian folk songs in 35-40 volumes and is working on a general work "A history of Latvian folk literature".

The Section of Dialectology and History of Language, dictionaries, grammar and folklore carry out annual expeditions for the collection and study of linguistic and folklore material. A wide circle of lecturers and students in higher educational establishments and schools are attracted to this work.

A large part of the work of the Institute of Language and Literature is concerned with the study of the history of Latvian literature (the Literary Section is directed by Candidate in philosophical sciences K. Kundzins). During the period of its activity, the Section has published many works, of which the most important are as follows: the work of the national writer, Academician A. Upit "Latvian literature" (volume 1); the monograph of M. Vilvye - "Andrey Upit"; Ya. Upit - "Andrey Upit as a literary critic"; A. Vilson - "The revolutionary poet and thinker, Eduard Veydenbaum"; "The national writer E. Birzniyek-Upitis"; "The classicist of Latvian literature Rudolf Blaumanis"; E. Sokol - "Raynis and the first Russian revolution"; "The life and work of Ya. Raynis"; I. Bechman - "Anna Sachs"; Ya. Upit - "80 years of Andrey Upit"; Ya. Kalnin - "In the light of keen satire" (the comedies of Andrey Upit); K. Kundzin - "The repertoire of the Latvian theater" and other monographs and outlines. The Institute of Language and Literature has produced many collections of articles on questions of language, the history

and theory of literature and on national literature. The Section has carried out a considerable amount of work on writing a large collective work in six volumes "A history of Latvian literature" (four volumes have already been printed.).

A recent addition to the Institute of Language and Literature has been the Section of "Textology" which began work on the preparation of an academic edition of the collected works of national writer Ya. Raynis in 28 volumes (the Section is directed by Candidate in philosophical sciences Ya. Kalnin). Work has also commenced on problems of the theory of literature and the literary connections with the Russian and other nations.

The collections of articles "Works of the Institute of Language and Literature" have been systematically appearing. Eleven editions have now been printed.

The Institute of Language and Literature began its work in 1946 under the direction of the national writer, Academician Andrejs Upīt. Now the Institute is directed by Candidate in philosophical sciences E. Sokol.

The Ya. Raynis State Literary Museum works within the Institute of Language and Literature. In the Museum are kept the works of the most important writers of the Latvian nation. The museum also carries out scientific research work, at the moment concentrating on the study of the works of the national writer Ya. Raynis. Already two volumes of a series "The literary works of Ya. Raynis have been prepared.

The Fundamental Library of the Academy of Sciences of the Latvian S.S.R., founded in 1946, has grown into a powerful cultural establishment. The present stock of the library consists of over a million volumes, mainly on scientific literature published in the Soviet Union, in the countries of the national democracies and in the countries of the capitalist world. Exchange of scientific literature from the Fundamental library is carried out by 200 libraries in 34 countries in the world. There is a large collection of archives, rich and many aspected catalogues of literature and well-organized bibliographical work.

We must mention too, the great scientific popularizing work carried out by all departments of general sciences. By issuing brochures, publishing many articles in journals and newspapers, by developing a wide propaganda by means of lectures and so forth, the staff of the institutes actively take part in the work of the Society for

### Propagating Political and Scientific Knowledge.

The Institutes of the Department of General Sciences of the Academy of Sciences of the Latvian S.S.R., in addition to scientific expeditions, hold also annual sessions and conferences on the most important problems of science. As a rule scientists of the Academy of Sciences of the U.S.S.R. and various other Republics of the Union (the Estonian and Lithuanian S.S.R.'s and others) take part in the work of these sessions and conferences. The Institutes of General Sciences coordinate their research work with that of higher educational establishments, the scientific academies of other soviet Republics and with the corresponding Institutes of the Academy of Sciences of the U.S.S.R. A friendly spirit of collaboration is one of the beneficial conditions of development of the general sciences.

We should also mention the fact that general sciences are also developing successfully in the higher educational establishments of the Latvian S.S.R., especially in the Latvian State University in the Institute of the history of the Communist Party and in the pedagogical institutes. The wide development of general sciences in the Latvian S.S.R. is one of the numerous signs of the creativity of Marxist-Leninist ideas.

In the years of the five-year plan after the great war for the fatherland, there took place in the Latvian S.S.R. a cultural revolution: general eight-year and secondary education has been successfully put into practice, the number of pupils in special secondary and higher educational establishments has grown to three times the figure for 1940; there are in the Republic over 2,900 large libraries (in 1940 there were 174), about 1,300 clubs (in 1940 there were 92), about 600 cinemas (in 1940 there were 77), the publication of books exceeds 10 million copies per annum (in 1940 the figure was 2.9 million). Great successes have also been achieved in the development of artistic literature and also in the field of pictorial and plastic arts and in music. All this testifies to the fact that in the history of Latvia there has never been such a powerful and many-sided flourishing of the culture of the Latvian people as we now have in the Latvian S.S.R.

Success in the realm of general sciences is a part of this blossoming, which is socialist in content and national in its form as the culture of the Latvian people.

## PROGRESS IN PHYSICAL AND TECHNICAL SCIENCE IN SOVIET LATVIA

by A. Malmeisters

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Physical and technical science in Soviet Latvia has developed and is developing in close liaison with the whole of Soviet science. Latvian scientists are receiving everyday help and consultation from leading teams of scientists in Moscow, Leningrad, Kiev, Sverdlovsk, Novosibirsk, and other scientific centers. Our scientific institutes and laboratories are furnished with home-produced research equipment and apparatus.

The broad scope of scientific research in the fields of physics, astronomy, and engineering can be illustrated by the following, by no means complete, list of lines of research and results.

### Atomic Physics. Application of Radioisotopes and Radiation

For the study of the structure of the atomic nuclei of various isotopes the nuclear spectra have been determined. From these spectra the decay schemes of interesting nuclei have been worked out, and this has enabled the nature of the processes occurring in them to be determined.

Original apparatus has been designed for nuclear spectroscopic studies. A scintillation spectrometer for multiple coincidences in radioactive decay, and a similar instrument for summed coincidences, have been constructed. Two magnetic spectrometers, where the

charged particles are "sorted" by a magnetic field, very complex pulse height analyzers, and so on, have been built. Of great practical and scientific importance are the studies of gamma-ray scattering in materials, and the study of the effect of irradiation on processes in halogen counters and crystal scintillators.

Considerable work has been done in the field of application of radioisotopes as a new tool for industrial automation. A radioactive relay, which in several cases is a serious competitor to the photo-relay, has been developed. The radioactive relay is now being used as a contactless transducer for level, position, absorption coefficient, etc. Studies have been made of the use of radioactive marking of cold-rolled steel sheet, and for wire-drawing. The principle of the radioactive relay has also proved to be applicable in the construction of devices for continuous measurement. An all-purpose radioactive thickness meter, which uses the degree of absorption of radiation to control the thickness of steel sheet, glass, paper, etc. in continuous production processes has been designed.

Scientists of our republic are pioneers in the use of radioisotopes for the automation of industry. The instruments devised for this purpose have been displayed on several occasions at international exhibitions and are now in serial production.

In 1960 the building of the experimental atomic reactor should be mainly completed. When it goes into operation the opportunities for research in atomic physics will be greatly expanded. In the field of practical application of atomic energy it will be possible to turn from control methods to the technological application of large quantities of radioisotopes, particularly short-lived ones. Isotopes and radiation will be used much more extensively in other fields of science.

The scientists of the Latvian Academy of Sciences have done a great deal to strengthen the link with industry. In particular, in cooperation with the workers in the Latvian Council of the National Economy they have gained great experience in the introduction of radioisotopes and nuclear radiation in the industries of the republic. G. Gaile, President of the Latvian Council of the National Economy and Honored Scientific and Engineering Worker of the Latvian SSR has taken an active part in the development of the use of atomic energy for peaceful purposes.

#### Physics of Magnetic Phenomena

Several investigations in magnetodynamics have been carried out. The magnetic spectra of ferromagnetic materials have been investigated, and the law of displacement of the dispersion band of magnetic permeability on magnetization has been obtained. The phenomenon of the nonlinear surface effect in strong fields has been studied by the method of simulation and physical similarity; the effect of the



Corresponding Member Acad. Sci. Latv. SSR, First Secretary of C.C. of C.P. of Latvia A. Pelše and First Vice-President of the Soviet of Ministers of Latv. SSR M. Plūdons at the laying of the foundation of the atomic reactor.

circuit parameters on the surface effect has been demonstrated.

The theory of similarity of nonlinear magnetic phenomena has been developed. This has made it possible to simulate electromagnetic devices on the basis of approximate similarity. The similarity method has been used to solve problems of the fine features of field distribution in the interpole gap of the cyclotron and beta-



Acad. K. Plaude, President of the Acad. Sci. Latv. SSR.  
Corresponding Member of Acad. Sci. USSR.

spectrometer, magnetization of ferrodielectrics (an aggregate of ferromagnetic particles pressed into a dielectric), the distribution of magnetization along a finite ferromagnetic cylinder in a homogeneous magnetic field, and so on.

Considerable attention has been devoted to studies in the field of magnetohydrodynamics of liquid metals. A method of calculating electromagnetic pumps has been devised, the principles of simulation of magnetohydrodynamic effects have been worked out, several results have been obtained in regard to effects in the boundary layer of a liquid metal and electrolyte under the action of forces of electromagnetic origin.

### Computer Technique and Mathematics

A series of investigations of new tools of computer technique has been carried out. New analog devices on the transformer principle have been designed for the calculation of furnace charges and the computation of algebraic forms.

A digital computer, type M-3, which has several advantages of design over other small machines of this class, was designed and was built with the assistance of the VEF plant.

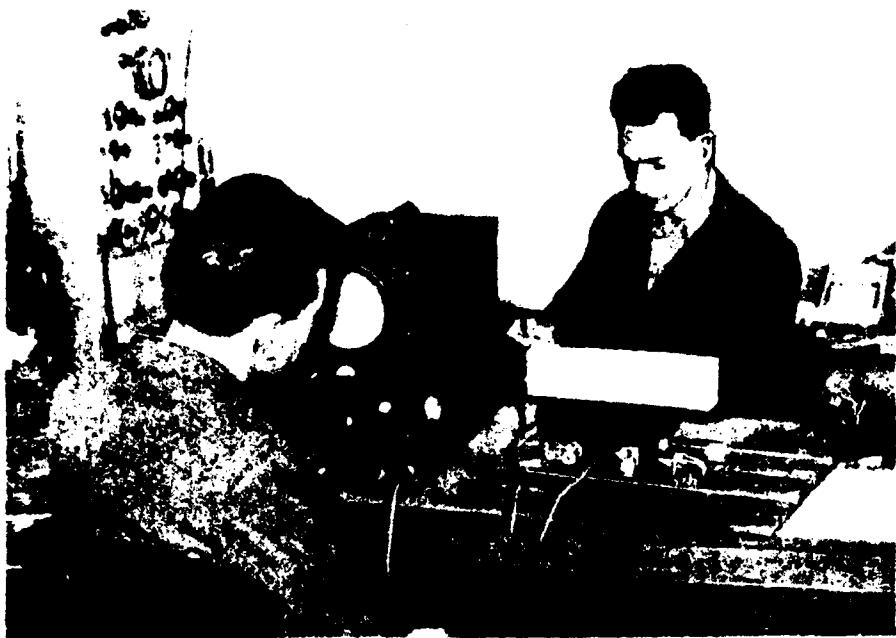
As regards programming technique, certain methods of simplifying the compilation and checking of programs, or the partial automation of these processes, have been developed.

Standard programs for the solution of elementary functions and for other commonly required calculations have been compiled for the M-3 computer and have been checked in operation. Many specific problems have been programmed and, where possible, the calculations for most of these programs have been carried out on electronic computers. Research on the wider application of electronic computers has been carried out.

### Astronomy

The proper motions of red giants are being investigated. For statistical studies, as we know, the greatest possible amount of factual data is desirable. Hence, the determination of all the possible proper motions of red giants from meridional and photographic observations of the positions of the stars has been undertaken. For this work 416 stars of spectral class C and S, 1084 variable stars of spectral class M of not less than 11th magnitude at maximum, and 774 stars of constant magnitude and stellar class M with known radial velocities, were chosen. A card index was compiled for these 2274 stars and all the observed positions and other characteristics (spectrum, luminosity, type of variation of luminosity) were recorded in it. About 400 catalogs of stellar positions were consulted and about 25 000 positions extracted. Catalogs from the libraries of the Riga, Moscow, Pulkovo, and Tartu observatories were used in this work. The necessary catalogs were also obtained from the Washington, Greenwich, Yale, Cape, Bonn, and Heidelberg observatories. The Pulkovo Observatory has made many photographic observations of the positions of red giants.

Further work will involve the correction of the present inaccurately known proper motions and a new determination of the proper motions of all the other red giants for which 3-5 positions have been determined over a period of not less than 30 years. The obtained proper motions of red giants will allow a much wider and deeper development of scientific research in the field of stellar cosmogony.



I. Spincis and A. Balodis of the Laboratory of Physical Methods of Concrete Testing of the Institute of Building and Architecture test new apparatus.

Observations of red giants in the red and infrared regions of the spectrum are very important for the determination of genetic properties. For this purpose a special electric photometer with a radiation integrator has been constructed. With the aid of filters this instrument can detect slight changes in the emission of a star. In 1959 the photometer was tested in the laboratory, and in 1960 large scale observations of stars with the 200 mm refractor are planned. Preliminary work on infrared stellar photography by means of photomultipliers is being undertaken.

The Astrophysical Laboratory is taking part in the radio service of the Sun in the USSR. Observations of the integral radio emission of the Sun on wavelength 1.5 m are being continuously conducted, from the Far East to Rijekstukalns station in the west.

In its early years the Astronomy Section carried out calculations of the ephemerides of the minor planets, and these were systematically published in the "Ephemerides of Minor Planets" of the Academy of Sciences USSR. At first the section gave approximately 200 ephemerides per year. In view of the mechanization of calculations

in Riga only the ephemerides of 11 minor planets are now being calculated, and for these the perturbations of several planets are taken into account. However, the acquired knowledge and skill have enabled the conduction of several major researches involving the use of numerical methods of celestial mechanics.

#### Scientific Bases of All-round Development of Power in the Latvian SSR

This problem involves the study of problems associated with the fuel balance of the Latvian SSR, with the structural changes in this balance and the development of the scientific bases for the creation of a power system for the North West of the USSR.

The study of these problems has been conducted in several stages. In the first stage (1946-1950) problems associated with estimates of power resources of the Latvian SSR and their efficient utilisation were tackled.

The second stage (1950-1956) was characterized by research on the linking up of power systems and a study of the operation of electric stations in a common system. During this stage there was an extensive development of research on heat-supply systems and their automation and on the use of high-temperature heat transfer media for heating.

The third stage of the investigations began in 1957. This stage is concerned mainly with a study of the scientific bases of the structure of the heat and power balance of the republic for 1959-1965, and with the general plan of the power balance (1960-1980).

Considerable work was done in the second stage on the problems involved in town heating. The most important results in this field have been obtained in the study of problems associated with steady consumption conditions and comfort in heated dwellings, and also in the improvement of the efficiency of heaters.

The extension of research on automation has led to the construction of a whole series of simple and reliable automatic units for the automation of heating in various productive processes in which water and steam are used.

For instance, the use of these automatic units for fermentation in a Riga yeast factory and for the steaming of the raw material in the Bolderaja spinning combine has led to a considerable reduction in the time of these processes, as well as to an improvement in the quality of the products and less wastage.

The results of research are being widely applied by Gosplan of the Latvian SSR, the Board of Power, and also the planning boards (Gidrocenergoprojekt, Teploenergoprojekt, etc.), and are saving millions of roubles.

The only fuel in the Latvian SSR is peat. Hence, studies of the efficient utilization of peat for power are being conducted.

Research is being carried out along two lines: intensification of peat combustion processes and utilization of raw peat for power.

#### New Electrical Supply Systems for Means of Transport

The necessary preparatory work was conducted in 1951-1953 and when the design was worked out the first models of contactless synchronous generators with claw-shaped poles and an externally closed magnetic system were constructed in collaboration with the Riga RUM electric machine factory. In 1954 the scope of the problem was extended, and questions of electrical supply for cars are now being tackled from every aspect.

A group of problems connected with the automatic regulation of voltage and the charging of the storage battery is being studied. These investigations have led to the design of a new system of electrical supply for rail cars -- by rectified alternating current.

Tests of the operation of the new system were organized by the Ministry of Communications USSR in 1956-1957. As a result of these tests the system received a high evaluation and was recommended for introduction.

For the invention and industrial adoption of the new electrical supply system a group of workers of the Institute was awarded a First Degree State Prize of the Latvian SSR.

The designed equipment is now being further improved. Special mention should be made of the construction of generators with built-in germanium rectifiers. This has enabled a considerable reduction in the weight of the generating unit. An original battery-charging device incorporating germanium rectifiers has been designed.

Studies of the automatic regulation of synchronous generators have led to considerable progress in the application of semiconductor devices (diodes and triodes) and magnetic amplifiers in control systems.

The research being carried out on the design of new synchronous electric motors appears very promising.

#### Structural Damping of Machine Parts

For a long time research on vibration damping was concerned mainly with the internal friction in the material. However, it was subsequently found that in the vast majority of cases the energy dissipation in the connections of machine components was of incomparably greater importance and was responsible for limiting the amplitudes of the vibrations. Methods were devised for calculating the energy loss in various machine connections (screw and nut, built-up beams, riveted joints, pressed joints, etc.) working under vibration. The accuracy of the existing methods of designing machines operating in dynamic conditions was thus considerably improved. The obtained



G. Gaile, President of the Council of the National Economy of the Latv. SSR, Honored Scientific and Engineering Worker of the Latvian SSR.

results are now being used in the motor- and turbine-building industry and will evidently find wider application in future.

#### Elements of Theory of Dry Friction and Cohesion of Metals

Of very great importance for various branches of mechanical engineering is the study of cohesion -- the sticking of metals. As most research workers believe, this phenomenon underlies the dry friction process, which is encountered in some degree or other in all frictional parts of modern machines, and also in the case of structural damping. This effect also determines the physical nature of such technological processes as various methods of pressure-welding of metals, sintering of metal-ceramic compositions, etc. Systematic research on cohesion has been carried out. The mechanism of the onset of cohesion in real conditions of contact has been established. The results of these studies have led to a soundly based qualitative theory of the dry friction process under large specific loads and, in addition, to the elements of the theory of several technical processes involving metal cohesion -- cold welding of metals, welding of metals

by ultrasound, and friction welding of metals. The results of these investigations are being widely used in industry.

#### Study of Phase Transformations in Iron-Carbon Alloys

Utilization of the existing means of strengthening machine components by heat treatment requires a knowledge of the phase transformations occurring in different types of treatment. Conducted investigations resulted in the obtention of the so-called hysteresis loops characterizing the direct and reverse transformations of gamma and alpha phases, and the effect of various factors on their nature was determined. The hysteresis loops characterize the quantitative relation of the phases involved in transformations, and also determine the critical temperatures of transformations of the martensite type. A study of phase transformations in several alloys of the transitional class have shown that their hysteresis loops are typical of alloys with unstable austenite decomposing by transformations of the martensite type.

Of great importance are the studies of nitriding processes involving high-temperature heating. These investigations showed that it was possible in principle to reduce the time of surface nitriding from several hours to several minutes, and hence this means of hardening could be incorporated in an automatic production line.

#### Mechanization and Automation of Product Control

Instruments for mechanized control of the thickness of any galvanic coatings on any base have been designed. With these instruments the control process is speeded up by a factor of several tens. Instruments of the UP-2 type are also being used for controlling the properties of surface layers of metal (electrical conductivity, surface continuity) and can be used for control of thermochemical treatment. The designed instruments can also be employed for active automatic control of processes in galvanizing baths.

#### New Methods in Concrete Technology

As a result of investigations of the physicochemical laws the structure formation of concrete has been worked out, and a new mode of preparing the concrete mix -- by vibro-mixing -- has been proposed. When a concrete mixture is loaded into a simple drum mixer and circular vibrations are imparted to the drum the concrete mixture at particular vibration frequencies and amplitudes passes into a "liquid" state, which is due to the great dispersion of the distribution of velocities of the individual grains of the mixture. This latter effect ensures, from the mechanical viewpoint, very rapid mixing and the obtention of a homogeneous composition and, from the viewpoint



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of physical chemistry, the activation of the grains of the cementing substance, the activation of the surfaces of the aggregate and an improvement in the workability of the concrete mix. The effect of vibro-mixing is used practically in two ways: to achieve a saving of up to 20-30% in cementing substance and to reduce the time of hardening of the concrete (autoclaving, steaming, vibration). The latter considerably increases the output of factories producing precast ferro-concrete. The method of vibro-mixing is being successfully introduced in the production of prestressed ferro-concrete units, in the production of silicate brick, and in the building of asphalt-concrete road surfaces.

#### New Kinds of Building Materials

An investigation of the great heaps of power station ash has led to the development of methods of manufacturing new building material — ash silicate and ash concrete — which can be precast in the form of large wall blocks. From such material more than ten houses with good technical specifications and at a satisfactory cost have been erected.

Comprehensive studies of the actual service of gas concrete in

reinforced structures have led to the development of official standards and the technical conditions for the design and production of reinforced gas concrete.

An investigation of the properties of local resources of non-metallic minerals has enabled the grade of Roman cement to be increased from 25-35 to 150 and to its recommendation for use in ordinary as well as in light concretes. The exploitation of certain clay beds for the production of "keramzit" and facade ceramics has also been recommended.

#### Nondestructive Methods of Determining Strength of Concrete

An investigation of the correlations between the strength of concrete and its other properties led to the establishment of theoretical relationships between strength, on one hand, and the elastic and inelastic characteristics of concrete, on the other. It was shown that the more use is made of the inelastic characteristics (vibration decay coefficients, coefficient of structural inhomogeneity, etc.) in the indirect determination of the strength of a concrete sample or ferro-concrete unit, the more accurately the quality of the component can be determined without destruction.

An electronic apparatus using acoustic and ultrasonic methods of determining the elastic and inelastic characteristics of concrete has been designed. The nondestructive method and the corresponding equipment are recommended for continuous control of production in factories producing precast ferro-concrete.

#### Theory of Plasticity of a Quasi-isotropic Body

A complex stressed state of a material can be achieved by simple loading, when the stresses along different axes increase in proportion to one parameter; or by complex loading, when the stresses along different axes increase arbitrarily. The existing theories of plasticity do not permit a prediction of the development of plastic deformations under complex loading.

From an analysis of the microdeformation of a quasi-isotropic body a theory of plasticity has been developed and this enables the solution of problems of plasticity theory for the case of complex loading.

Methods of applying this theory to materials such as concrete have been worked out.

The recounted achievements clearly indicate that the republic now has a solid foundation for the further rapid development of research in the field of physics and engineering.

## ACHIEVEMENTS OF CHEMISTS IN THE TWENTY YEARS OF SOVIET LATVIA

by A. Kalnins

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In the last 50 years chemistry has taken giant strides forward not only in making available to man many natural products previously almost inaccessible but in producing completely new substances. The organic chemistry industry is meeting more and more fully the demands for artificial fibres, expanding the production of sugars by hydrolysis and protein yeasts on the basis of plant waste, while increasing the output of cellulose and its derivatives from the most diverse plant sources. In his report to the Twenty-First Session of the Communist Party of the Soviet Union, Comrade N. S. Krushchev correctly pointed out that "development of the chemical industry makes possible the most effective utilization of the natural wealth of the country and is a necessary condition for further technical progress in all branches of the national economy".

All the most important chemical and technological processes are based on modern developments and are being perfected through extensive theoretical research. Such research has also been conducted in the Latvian Republic - at first in the chemical faculty of the Latvian State University, later in three institutes of the chemical section of the Academy of Sciences of the Latvian S.S.R. and also in the chemical faculty of the Riga Polytechnic Institute and in various departments of chemistry in other institutes of higher education throughout the Republic.

In the field of inorganic chemistry, the work of D. Keshan, begun in 1945, on the synthesis and study of borates in aqueous solution must be noted. Detailed study of the chemistry of borates is aimed at extending our knowledge of the chemistry of boron itself, thereby opening the way to the use of low percentage ores, natural brine and industrial effluents. Keshan and his colleagues have studied over thirty hitherto unknown borates. It was found that in aqueous solution various polyborate anions can form only within definite pH limits, and therefore, on crystallization of these borates, the pH of the solution must remain constant over the given limits. Determination of the electrical conductivity and van't Hoff's cryoscopic coefficient for various borates has yielded information on the state of borates in aqueous solution confirmed by means of extraction of boric acid with isoamyl alcohol (Shvarts). Boric acid readily reacts with organic polyhydroxy compounds (tartaric, trihydroxyglutaric, mucic and other acids). Shvarts has been able to obtain a number of compounds of this type with very low solubilities.

The study of the structure of borates has also gone ahead. Ozols and Vimba have elucidated the structure of calcium and barium baborates.

A considerable number of borates has been characterized crystallographically by X-ray diffraction. In individual cases the parameters of the unit cell of the crystal have been determined with a high degree of accuracy through the further development of the method of asymmetry which has made it possible to determine with an accuracy of up to four decimal places the parameters of the unit cell even for crystals with such a low degree of symmetry as, for example, the monoclinic and triclinic (Yevinsh, Ozols). In powder diffraction analysis the accuracy can be raised to five decimal places (Yevinsh, Ozolins).

The properties and conditions of formation of artificially prepared modifications of calcium carbonate and also the effect of various factors on their stability have been investigated. The carbonization of aqueous solutions of calcium hydroxide in various states has been studied and it has been shown for the first time how the process of carbonization must be conducted to obtain precipitated chalk complying with technical specifications (Oshis, Yevinsh).

Work has been done in exploring the possibilities of producing caustic soda by thermal decomposition of sodium nitrate in the presence of iron, manganese and other metallic oxides. At laboratory level, the yield of dry

caustic soda in the presence of water vapor reached 92 per cent and in the presence of nitric acid 96 per cent (Osipov, Yevinsh).

In analytical chemistry most of the work done has been devoted to a study of intracomplex compounds of 8-mercaptopquinoline (thiooxine) (Bankovskiy, Yevinsh, Luksha and others). The highly favorable atomic grouping in this compound is the reason for the formation of very stable five-membered rings with many elements and in a number of cases (Cu, Pd, Re, Mo) of very stable and strongly acidic solutions, which has opened up prospects of a direct colorimetric assay of a number of metals in complex mixtures. In definite conditions, the specificity of the test for certain elements (Cu, Pd, Re) is so high as to allow determination of traces of some elements in the presence of an overwhelming majority of others. Using the high stability of rhenium thiooxinate in almost concentrated hydrochloric acid, it is possible to determine this element against a background of large amounts of the substances normally accompanying it - molybdenum and tungsten - as well as nearly all the metals of the periodic system.

High selectivity is shown by the photometric method in the determination of palladium in 6 NHCl together with thiourea which allows determination of gamma amounts of palladium in the presence of considerable quantities of the other platinum metals. The tests for rhenium and palladium are the most specific of any described in the literature. The photometric method for copper permits determination of this element in the presence of large amounts of iron, manganese and other metals. Recently, a new reagent for copper has been developed on the basis of thiooxine. This is 8,8'-diquinolyl disulfide, in sensitivity equal to thiooxine but considerably surpassing it in specificity and allowing the determination of copper when present with very large amounts of other elements, gold excepted. Great interest, especially among foreign scientists, has been aroused by the micro-method of thiooxine determination of calcium in biological material. Thiooxine methods have also been used for determining manganese, molybdenum and vanadium. Some halogen derivatives of thiooxine have been developed and a number of salts prepared. The study of oxygen- and sulfur-containing analogs with uniform structure is also of great importance for the construction of a general theory of the action of organic reagents. It is highly probable that some properties, peculiar to both reagents, are more clearly brought out in 8-mercaptopquinoline than in oxine.



Academician AS Latv. SSM R. Caincovs in his lab.



Academician AS Latv. SSP Professor L. Lepin.

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Among other sulfur-containing complex compounds, trithiocarbonic acid complexes of nickel, cobalt, iron and manganese have received attention (Bankovskiy, Yevinsh).

Also noteworthy is the work done by Yevinsh, Gudrinietse, Veis and Yanson on the analytical application of sodium tetraphenyl borate in the determination of potassium, rubidium, cesium, ammonium, thallium and some aliphatic and aromatic amino and nitrogenous compounds. An assay of gamma amounts of potassium by coprecipitation with ammonium tetraphenyl borate has been devised (Yevinsh, Peinberg).

Great attention has also been paid to methods of determining calcium (Yevinsh).

The destructive action of trilone B on various makes of glass has been studied; it has been shown that even the most stable glasses undergo considerable destruction in alkaline solutions of trilone B, resulting in components of the glass passing into solution (Bankovskiy, Yevinsh, Lukaha).

In the field of physical and colloidal chemistry we may mention the following lines of study being pursued by Latvian chemists.

(a) Study of sorption of electrolytes, including adsorption, chemosorption and surface chemical reactions in both elementary and more complex solid bodies (ashless activated charcoal, charcoal with metal (Ag) applied to its surface, metallic oxides and hydroxides).

(b) Study of the kinetics and mechanism of certain heterogeneous reactions, in the main, processes of oxidation of metals in water and aqueous solutions (corrosion of metals).

Among the most important results of this research are the following.

(1) A general review of the experimental findings on sorption of electrolytes by ashless activated charcoal in an atmosphere of oxygen has shown that the surface reactions of complete exchange on charcoal are governed by the phase rule and law of mass action which has made it possible to find a quantitative relationship between sorption of ions and concentration of the electrolytes (salts, acids, alkalies), the pH of the medium, partial gas pressure temperature and concentration of other electrolytes present (Lepin, Nurgalieva).

(2) The sorption properties of hydrated metal oxides (Al, Fe, Cr) depend on their crystalline structure and the

character of the structural elements of the crystal lattice. In solutions of the natural salts of the metals it is possible to observe transition from adsorption of ions to chemisorption with formation of basic salts of the given metal, the sorbent becoming amorphous and swelling with conversion of the entire system into the salt. Complex polymer salts of aluminum with interesting optical properties have been obtained (Lepin, Veis, Groskaufmanis).

(3) On oxidation of metals in aqueous solutions of salts a key role is played by the colloid-chemical, including electrokinetic and also electrical (electrical conductivity) properties of the films and sediments formed on the metal surface, especially if its surface is non-equipotential and the oxidation process has an electrochemical character. The role of pH in salt solutions and changes during corrosion of metals has been clearly revealed for the first time (Vaivade, Lepin) and a connexion established with the changes in the electrode potentials of the metals (Kadekpurin). A new method of determining the conductivity of boundary layers has been devised (Balodis).

(4) Systematic research into the phase and chemical composition of the oxidation products of such important metals as iron and aluminum has been initiated and continues. Changes have been established in the composition of products with change in the character of the electrolyte, in the pH of the medium and the temperature (Oshin) making it possible to develop a theory of the processes on a sound experimental footing.

(5) The kinetic laws governing the processes of oxidation of metals in salt solutions under static conditions turn out to be identical with those established for gaseous (so-called chemical) corrossions; this shows that under these conditions the process regulating the overall speed of corrosion is one of diffusion through the thickness of the films and deposits, the character of which is altered by changes in temperature and in the composition and properties of these deposits (Vaivade, Lokenbakh, Lepin). The result is a change from linear to parabolic and cubic, logarithmic and antilogarithmic relations between the amount of metal oxidized and time.

(6) It has been established that the electrokinetic properties are fundamental not only to the mechanism of inhibition of oxidation of metal by natural films but to the mechanism of protection of the metal by means of varnish coats artificially applied (Myagkov, Lepin).

(7) Both massive samples of metals with a small surface and highly-crushed metals (cinders) with a very

developed surface have been investigated (Smidts, Tetere). This has given a deeper insight into the mechanism of the actual process of interaction of metals (Al, Fe) and water and has permitted a number of statements on the hydride mechanism of metal-water reaction (Lepin), which are gradually finding recognition.

In the laboratory of electrochemistry, through research into the electroprecipitation of metals, a sulfate-chloride-ammonium electrolyte has been developed for zinc plating because of its increased dispersion power and has been introduced on a commercial scale; a method of electrode precipitation of nickel on a nickel base by superimposing alternating and direct current to obtain a very thick nickel plating with good cohesion to the base has been devised, while positive results have been obtained in precipitating a shining copper coating directly on an iron base with a non-cyanogen electrolyte.

The Latvian S.S.R. possesses non-metallic mineral sources suitable for use in various branches of the national economy and, in particular, in the production of building materials.

Extensive work has been done in studying the typical local clays (Eiduk, Vaivad, Karlson). This has demonstrated the suitability of various types of local clay for making not only bricks but other products as well, for example, fine and porous ceramics, porous clay fillers, clinker, artificial hydraulic additives, etc.

Research into vitreous substances has been carried out with the aim of obtaining readily fusing ceramics, building ceramics and china glazes not containing tin, lead and boron (Eiduk, Vaivad, Kukurs). After long and patient work, it was possible to establish a theoretical base for obtaining such glazes. Moreover, a number of the glazes developed have been introduced into commercial practice (enamels for cast iron have also been investigated by Eiduk and Pauksh).

Recently work has started on the possibilities of producing textile glass fibres from local raw materials.

Ceramic dielectrics are being studied (Freide, Vild). In  $\text{CaO}-\text{BaO}-\text{TiO}_2$  systems the limits for solid solutions and also the dependence of the dielectric parameters on compositions have been determined.

Great attention is being paid to research into gypsum (Eiduk, Vaivad, Gofman). The effect of the dehydration conditions on the phase composition of gypsum has been established and also the conditions for the formation

of highly stable gypsum with long setting time. The best retarders of gypsum setting have been discovered; and the suitability of gypsum combusted at 700° as a filler for paints and paper established. The forms of hydrated  $\text{CaSO}_4$  and their properties have been investigated in detail.

Among the many varieties of local sands, that of greatest interest is quartz sand (Eiduk); methods of enriching these sands have been worked out and their suitability for glass manufacture and as core sand assessed.

Research has been conducted into ways of improving the quality of dolomite Roman cement in the Sloks Cement Factory which has made possible the introduction of dolomite Roman cement grade 150, in place of the usual grades 25 and 50 (Gofman, Vaivad, Karlson).

A study of the thermal dissociation of local dolomites and the interaction of combusted dolomites and water has established the optimum conditions for obtaining high-quality caustic dolomite and unslaked, ground dolomite lime. These investigations showed that dolomites burnt at a temperature below 1,000° contain magnesium oxide in a quite active form and that setting and hardening of unslaked ground dolomite lime is thereby promoted. When combusted above 1,000° the magnesium oxide sharply loses activity; the slow hydration of the magnesium oxide produces internal stresses in the samples with resulting loss of stability, increased size and final destruction of the samples after a certain time. Addition of unburnt gypsum to the dolomite lime during hydration promotes packing of the gels and crystallization of calcium and magnesium hydroxides, but sharply hinders hydration of magnesium oxide so that on hardening the samples expand and are even destroyed.

Dolomite research has been carried out with the aim of improving the quality of sand-lime bricks on the basis of unslaked dolomite lime (Vaivad, Karlson, Miller). As is known, sand-lime bricks slowly gain stability and especially resistance to frost. To speed up the aging process, a method of artificial carbonization has been devised which gives good results when tested under production conditions. On the basis of these results the Central Co-ordination Bureau for administration of local industry has drawn up a new project for a sand-lime brick factory which will utilize artificial carbonization. It is already being built.

With the addition of certain clays local burnt dolomites have been found suitable for silicate brick-making (Ozolinsh, Eiduk).

Recently work has begun on a search for new silicon organic compounds suitable for improving the quality of building and other materials and also for use as oils in the lubrication of molds, and in preparing gypsum and other products. The production technology of certain silicones with water-repellent properties has also been developed.

An important contribution to the development of the chemical industry of the Republic is also being made by research at the Institute of Geology and Minerals. This Institute has done much to chart the reserves of limestone and dolomite, valuable for the production of various forms of clays, sands, gypsum and other non-metallic minerals. Much work has been done on the classification of local minerals and artificial water-repellent treatment of various mineral materials, resulting in a new method for obtaining quality cold asphalt, which is already being applied in making of highway finishes.

Considerable work has also been done on the mineral waters and therapeutic muds of the Republic.

In recent years, important studies have been made into the distribution of heavy minerals in the sands of the Baltic coastal strip and in Riga Bay which may eventually give a possibility of winning certain rare metals on an industrial scale.

A great deal of work on a number of subjects in organic chemistry and chemical technology has been done by the Institute of Problems of Forestry and Wood Chemistry. From the day it was set up in 1946, this Institute has studied the most important aspects of the utilization of plant materials as starting materials for the chemical industry. The importance of this work grows year by year, since the time has now come when the production of plastics, cellulose, various types of artificial fibres and other heavy products has reached such proportions that the problem of raw material supplies for the organic chemistry industry has become a major world problem. Already a rough guess can be made of the time it will take for the reserves of the main types of raw material for the organic chemistry industry, in the form of coal tar, oil and natural gas, to start to run out. The raw materials of the future will undoubtedly be the waste products of wood and many forms of agricultural plant and as yet completely non-utilized plants, the stores of which are unlimited and yearly renewed through photosynthesis.

Plant waste is not only readily available but the

cheapest type of raw material, to which due attention has so far not been paid, primarily because of transport difficulties and problems of extracting pure products from the complex components of plants. These obstacles have already been largely surmounted. Even small branches and brushwood can conveniently be pressed into blocks with an oriented array of the branches by a method developed in the Institute of Problems of Forestry and Wood Chemistry of the Latvian S.S.R. Academy of Sciences (Yevinsh). A one cubic meter block weighs 650 - 700 kg and at the point of production does not cost more than 20 roubles. As shown by the work of the Scientific Council on the use of pentosan-containing raw materials etc., staged pulping or hydrolysis allows one to obtain from any plant, when fully exploited, such pure substances as furfurol, glucose, laevoglucosane, various alcohols, individual organic acids, phenols, activated charcoal etc.

The residues after falling and brushwood pressed into blocks, after being impregnated, can also be used as very cheap building materials for the walls of buildings. It is also possible to make them up into building and carpentry blocks: 1 cubic meter replaces not less than 2.5 cubic meters of board or about 4 cubic meters of sawn timber.

The work on obtaining blocks from wood particles is held back by lack of synthetic resin binders. The work of the Institute has shown that in nearly all cases, blocks of wood can be obtained by using the available binders such as active lignin and sapropel, or their mixtures with evaporated sulfite alkalis or the proteins of oil seed grist unsuitable as fodder. In the chemical faculty of the Riga Polytechnic Institute (Karlivan) a method has been worked out for obtaining solid building blocks from barely-putrified peat without addition of binders.

These possibilities, only roughly sketched, for using plants as raw materials for processing or as finished products for the most varied applications, are, in a number of cases, blocked by difficulties arising from our as yet poor knowledge of the physical and chemical properties of plant materials. Unfortunately, proper attention is still not being paid to this research, although elucidation of the theoretical bases of the chemical and mechanical processing of plant materials, as shown by the experience of the Institute of Problems of Forestry and Wood Chemistry, almost always discloses new possibilities for production processes.

Thus, for example, the study by Odincovs of the



Academician AS Latv. SSR K. Yevinsh heads the Institute of Chemistry of our Academy.



Academician AS Latv. SSR S. Giller, Director of the Institute of Organic Synthesis of the Latvian SSR Academy of Sciences, Stalin prizewinner.

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problems of the formation of cell wall components and their fine structure has already given a number of valuable clues to help in rationalizing the impregnation of plant materials with acids during hydrolysis; they can also be used in furtherance of the development of wood conservation technology. Discovery of the fact that the first stage of polysaccharide - cellulose - hydrolysis may proceed in the solid state has led to the Riga method of hydrolysis of plant materials using quite small amounts of concentrated sulfuric acid or its emulsions with oils.

Elucidation of the behaviour of xylan and xylose on heat treatment under various conditions has shown that the conversion of xylan into furfural on thermolysis is impeded by processes of anhydridization, which can be eliminated.

The work of Sergejeva and others has demonstrated some regularities in the formation of lignin and established changes occurring in the lignin molecule on treatment of wood with various agents. On thermolysis of lignin obtained by treating wood with concentrated sulfuric acid it has been shown possible to obtain more than 16 per cent resins rich in phenolic products. The possibility of obtaining aromatic aldehydes and acids from lignin is also under study.

For the first time, the possibility of controlled thermal decomposition of cellolignins has been demonstrated (Sergejeva). Here the cellulose is decomposed with preferential formation of laevoglucosan (30 - 40 per cent) and phenol products obtained via lignin.

Some encouraging results have been obtained as a result of work initiated by the U.S.S.R. Academy of Sciences Institute of High-Molecular Compounds and the Institute of Elemento-Organic Compounds with the co-operation of the Institute of Problems of Forestry and Wood Chemistry of the Latvian Academy of Sciences on the use of laevoglucosan in the synthesis of new polymers.

Two variants of the Riga method of hydrolysis of plant materials have been worked out using concentrated sulfuric acid. These variants are marked by the low amounts of sulfuric acid employed. The "monohydrate modulus", i.e. the ratio of the weight of absolutely dry raw material to the weight of sulfuric acid monohydrate, differs in these two methods of hydrolyzing various types of raw material. The yield of sugars for a definite working system has been raised to the theoretical.

With a "high modulus" of acid 100 - 150 per cent of the weight of the dry wood (modulus 1 : 1 to 1 : 1.5) is

used while for a "low modulus" only 10 - 30 per cent (modulus 1 : 0.1 to 1 : 0.3). The ground-up plant material dried in an air jet or other drier to a moisture content of 10 per cent, is mixed uniformly with the sulfuric acid. The practically dry mixture obtained is at once rubbed down or crushed between rollers or in other machines. The dark "hydrolysate mass" obtained, consisting in the main of cellodextrins, on cooling (in work with a low modulus) rapidly solidifies and can be transported in the form of briquettes and granules. It weighs about 1,200 kg per cubic meter.

The sugars do not decompose during storage of the hydrolysate mass for a month at ordinary temperatures and the reactions continue with increased yield of sugars. For complete conversion of the semi-products of hydrolysis into monosaccharides, the hydrolysate mass is usually mixed with water, the resulting pulp heated to 100 - 135° and kept at this temperature until the end of the "inversion" process. The invert pulp contains monosaccharides, organic acids and sulfuric acid together with the water-insoluble residue of lignin which is filtered off. The organic acids can be removed by extraction processes, the sulfuric acid is neutralized with lime. The gypsum thereby obtained, either alone or mixed with the lignin, is used to fertilize clover fields or saline soils. The neutralizate contains monosaccharides in solution to the extent of about 6 - 18 per cent; these are suitable for chemical or biochemical processing or can be isolated in pure form.

Advantages of the process are its simplicity with low chemo-protection of the ferrous metal apparatus and the low expenditure of steam in a continuous and easily automated method. The yield is about 40 per cent higher than in the present method of hydrolysis with dilute sulfuric acid using wood and agricultural (sunflower husks, straw etc.) waste as raw material. The increase in the output of sugars in the Riga method of hydrolysis is even higher, as shown by the experiments of Kalnina. A defect of the method, fully offset by its advantages, is the increased consumption of electrical power in grinding the hydrolysate mass, but there is every reason to hope that with the use of some new techniques the power consumption will be cut considerably. For individual cases of hydrolysis, it will also be possible to use a type of combined hydrolysis based on the Riga method - M/O of the All-Union Research Institute for Hydrolysis Sugars - in which the consumption of sulfuric acid is reduced still

further.

With a high expenditure of concentrated sulfuric acid, in the Riga method of hydrolysis, the latter is reused to obtain a precipitate as a by-product: half (about 0.8 tons for each ton processed dry wood) is used as fodder and the other half as fertilizer.

It is much cheaper to obtain the precipitate here than to produce it in special factories, which is a further advantage of the Riga method.

Preliminary results show that it is also possible to use active lignin obtained in the Riga hydrolysis method as a binder and raw material in the production of plastics. Here, however, the best results are achieved by using hydrotropic lignin, obtained as a valuable by-product in the amount of 300 kg per ton greenwood cellulose by the method of hydrotropic heat-treatment. One ton of aspen wood will give up to 560 kg cellulose containing about 90 per cent alpha-cellulose and as much as 76 - 78 per cent hemicelluloses. In the manufacture of phenol-formaldehyde plastics replacement of as much as 54 per cent phenol by active hydrotropic lignin, far from impairing, improve the quality of the plastic.

The improved method of hydrotropic treatment of greenwood cellulose with use of sodium xylolsulfonate worked out under the direction of Odintsov Gromov has been partially tested in a semi-industrial plant. Some furfural is produced in this process. Preparation of one ton cellulose and corresponding amounts of lignin uses about 20 kg of the hydrotropic salt. The temperature for hydrotropic treatment is 140 - 160°. According to rough calculations, the capital investments in building hydrotropic cellulose factories will be about a third less than those for sulfate cellulose ones of the same capacity. There is every reason to make maximum efforts to try out the method under production conditions, particularly since it is the only method of obtaining cellulose without discharge of any wastes polluting the air or nearby water.

If active lignin is applied to a fibre of hydrotropic hemicellulose (by dilution of solution), after pressing the mass in a hot press under a pressure of 40 kg/cm<sup>2</sup> and at a temperature of about 2000°C, solid fibrous blocks are obtained with the following physico-chemical properties:

Specific gravity	1.05 - 1.07
Breaking strength	270 - 300 kg/cm <sup>2</sup>
Transverse strength	760 - 1000 kg/cm <sup>2</sup>

Slightly modifying the technology of producing the



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blocks will increase their waterproof properties, make them less inflammable and increase their resistance to wear. The blocks can also be stained any colour and used as small parquet boards. The raw material for their production may be any greenwood and also debarked twigs and branches.

In organizing the production of glues, lacquers and other finishing materials, the properties and potentialities of rosin of varied origin and furfuran compounds have been explored in the Latvian S.S.R. (Sergeyeva). The search for new methods of chemical treatment in tapping pine and spruce is continuing. Tapping methods are being rationalized (Kalnins, Rupais, Rasinsk) and the possibilities of using stumps of newly-felled pine trees for the extraction of rosin and tar distilling explored. New methods of wood pyrolysis are being studied and the technology of tar distilling and the type of retorts used being considerably improved. Better methods of wood protection have been worked out.

The problems of impregnating wood are of exceptionally great importance to the national economy. Rational wood protection can save the Republic annually over 30 million and the entire Soviet Union up to 10,000 million roubles by allowing a considerable reduction in the country's requirements for commercial woods.

In close collaboration with production workers, these problems have been studied in the Institute for Forestry and Wood Chemistry (Kalnins, Ermush, Streipa) and in the laboratory of the Republic Branch of the Mendeleyev Chemical Society (Kalnin). New antiseptics have been extracted from the waste of tar distilleries, and methods developed for making building material water-repellent by means of new and improved protective paints using aluminum-bronze or potassium permanganate, etc.

In the Academy of Sciences of the Latvian Republic much attention has been directed to a study of the possibilities of obtaining and using furfural. At first, this research was conducted in the furfural division of the Institute for Problems of Forestry and Wood Chemistry but in recent years it has continued in the Institute of Organic Synthesis, ever since the latter was set up. The research begun in 1947 by Giller and Tarvide-Shimanskaya into the possibilities of vapor-phase catalytic oxidation of furfural with atmospheric oxygen has given highly positive results. A suitable catalyst has been found and the optimum parameters of the process established for obtaining maleic anhydride from furfural with a yield of

about 80 per cent of the theoretical. Work is already on hand for building two pilot production factories which will manufacture maleic anhydride by the new method.

Catalytic decarboxylation of furfural (under the direction of Giller) aimed at obtaining furfuran, tetrahydrofurfuran, etc. has also been studied. Work has been done on the theoretical and technological bases for nitration of furfural and the synthesis of a large number of nitrofurfuran medicinal preparations, reviewed in detail in a separate article.

All this work has encouraged the U.S.S.R. Academy of Sciences not only to entrust to the Academy of Sciences of the Latvian Republic the task of organizing the scientific council for use of pentosan-containing raw materials, which directs the relevant research work on an All-Union scale, but also of planning the building in the Latvian S.S.R. of a whole number of chemical and chemico-pharmaceutical factories to meet All-Union demands. S. A. Giller, Academician of the Latvian S.S.R. Academy of Sciences, and a number of other chemists of the Republic have been awarded the Stalin Prize, State Prize of the Latvian S.S.R., medals and diplomas of the All-Union Agricultural Exhibition, the All-Union Exhibition of Achievements in the National Economy and diplomas of the Supreme Soviet of the Latvian S.S.R.

The complete utilization of wood and plant waste, as we have seen, is already possible and economically advantageous.

This point also applies fully to the use of peat and sapropel.

In the Latvian Republic peat and sapropel can, as shown by the research of the Latvian Agricultural Academy (Braksh and Vimba) be used with success in agriculture as valuable components of organo-mineral fertilizers.

Most of the work of the all-round utilization of peat and sapropel has so far been coupled with the All-Union problem of the electro-technological uses of fuels and is being undertaken in the Institute of Chemistry. It is of importance to speed up this study since about 95 per cent of the peat dug in the U.S.S.R. is used as fuel, although by chemical composition and in economic terms, peat is more suitable for use as a raw material in chemistry. This applies with even greater force to the deposits of sapropel.

When fully exploited, peat and sapropel can yield phenols, nitrogenous compounds, furfural and furfuran compounds, nutrient yeasts, stable metallurgical peat

coke and semi-coke, high calorific gas for domestic use, activated charcoal and a number of other valuable products (Braksh, Bayars, Stonans, Vimba, Kalnina, Shkele, Dalbin, etc.). Research in all these directions has been done in the Institute of Chemistry of the Academy of Sciences of the Latvian S.S.R. Interesting results have also been reported by the Institute of Energy and Electrical Engineering (Indrikson) with its research program having as its final goal production of an all-the-year-round fuel briquette or raw material for chemical use on the basis of processing natural crude peat.

A scientific council has been set up by the Presidium of the Academy of Sciences of the Latvian S.S.R. to direct the research into applications of methods of peat and sapropel utilization in these and other directions. The council is concerned with the problem "All-Round Utilization of Peat and Sapropel" and on it sit representatives of eight institutes of the Latvian Academy of Sciences, the State Planning Commission of the Latvian S.S.R., the Scientific-Technical Committee of the Council of Ministers of the Latvian S.S.R., the Ministry of Agriculture and the National Economic Council of the Latvian S.S.R., the Latvian Agricultural Academy and the Riga Polytechnic Institute. By 1975-80 it is intended, according to preliminary plans, to produce from Republic peat up to 25,000 tons of furfuran compounds and yeasts, 10,000 tons of waxes and 750,000 tons of mineral-organic compounds annually. The output of products from the gasification or power-technological use of peat and sapropel will be fixed later depending on the results achieved by the relevant pilot plants.

It is clear from all this that in Soviet Latvia the research work of our chemists has assumed important dimensions and that the developments of new technologies is resulting in an ever-faster expansion of a chemical industry of increasing importance to the national economy of the Republic.

DEVELOPMENT OF BIOLOGICAL SCIENCES  
IN SOVIET LATVIA

by A. Ozols

Pages 63-75

In the pre-Soviet period there were no research institutes in Latvia which could independently develop important scientific problems or be guided by the scientific research of the individual departments of institutes of higher learning or experimental stations.

During the period of Soviet power in the Latvian Republic, biological, agricultural and medical research institutes have been formed, with laboratories supplied with modern equipment and apparatus and with a considerable number of qualified workers who, together with the numerous scientific staff of the corresponding departments of the Latvian State University, the Latvian Agricultural Academy and other institutes of higher learning of the Republic, are working on topical scientific problems.

Biological research has been widely developed during these years in the biological institutes of the Academy of Science which, together with the departments of higher colleges and agricultural institutes, are scientifically solving the highly important problems of raising soil fertility, increasing the yield of agricultural crops and the productivity of animal husbandry and as well as individual biological problems of great importance for the development of the national economy of the Republic. Results of great importance for public health have also been achieved in medical research.

The Institute of Biology of the Academy of Sciences of the Latvian S.S.R. was founded in 1951. The function of the Institute is to carry out research to solve theoretical and practical problems in the field of botany, plant and animal physiology, zoology, parasitology, hydrobiology and soil biochemistry.

Research of great theoretical and practical importance is conducted in the laboratory of soil biochemistry and trace elements directed by Corresponding Scientific Member of the U.S.S.R. Academy of Sciences, Professor J. Peive. A mobile laboratory has been designed for carrying out fundamental analyses of the soil, to ascertain its lime and fertilizers requirements and to determine the fertilizer value of peat.

Geographical maps have been compiled showing the content of the mobile forms of trace elements - copper, cobalt, zinc, molybdenum, boron and manganese - in the soils of the Republic. Simpler methods, which are amenable to mass application and at the same time quite accurate, have been worked out for determining the mobile forms of the trace elements Cu, Zn, Mn, Co, Mo and B in soils and plants. A field laboratory has been set up for determining the uptake by plants of trace elements in the soil.

The staff of the laboratory has been engaged on work to discover better methods of preparing peat-compost blocks in relation to the characteristics of the organic matter of the peat and the incorporated fertilizers and trace elements.

Research carried out in the laboratory has established the high effectiveness of the fertilization of plants with trace elements. Application of copper in the form of pyrite cinders in peat-marsh, turf-bley and certain other soils of the Republic has increased the yield of grain crops by 2 - 9 centners per hectare<sup>1</sup>, beetroot for sugar by 72.2 - 111.4 c/h and linseed by 22.4 per cent. Extra-root feeding of plants with molybdenum in acid turp-bley soils has increased the clover-hay yield by 11.8 - 17.74 c/h; peas by 3 - 4 c/ha. It has been established that when copper is introduced before sowing maize in the peat, turf-podzolic and sandy soils of the Republic, the green yield is raised by 50 - 70 per cent and the yield of ears by 87 per cent. In addition, the ears ripen much earlier.

(1) 1 centner = approx. 1 cwt.

The results of this research have been published in the collected transactions of the Institute "Trace Elements in Plant Cultivation" and a number of other scientific papers. The monograph by J. Peive "Soil Biochemistry and Trace Elements" (30 printed sheets) has also been prepared for publication.

The laboratory of soil biochemistry and trace elements is responsible for the coordination of all the research work on trace elements carried out in the U.S.S.R.

In the sphere of botany, work has been completed on a study of the meadow plant life of the Republic. Where the floral composition of meadow plants has been established, the phenology of the commonest individual plant species has been studied and the types of meadow and pasturelands characterized in relation to productivity and nutritional value. In addition, meadows have been typed and classified and also the yield of various types established. G.S. Sabardina has published a monograph "Meadow Plant Life of the Latvian S.S.R."

Under the direction of the Komarov Botanical Institute of the U.S.S.R. Academy of Sciences, the plant life of the Republic has been mapped leading to a geo-botanical map to the scale of 1 : 1,000,000. On the basis of this map, a map of the plant cover on a scale 1 : 400,000 has been compiled for secondary school requirements.

The results of this research have been published in two volumes of the collected transactions of the Institute "Plant Life of the Latvian S.S.R." and in a number of pamphlets and articles. A third volume of this collection is awaiting publication.

In the sphere of plant physiology much work is being done to study the winter hardiness of fruit crops. The basis of this work was laid in 1951 when research was begun aimed at discovering and studying in the Republic's national wealth of fruit varieties. As a result of many years' research by expeditionary teams many seedlings of fruit crops possessing valuable biological and economic properties and characters have been discovered. During 1951-1959, 475 valuable seedlings were found: 38 of these new national varieties were considered to have potentialities; 11 were isolated and studied by the department dealing with plant variety and have already been included in the standard stock of the Republic and 10 varieties have been adopted for state variety testing.

The findings of the study of varieties of national selection have been published in the book by A.K. Spolitis,



Corr.-member AS Latv. SSR E. Eihe, engaged in  
field research.

O. I. Romanovskaya and Ya. Ya. Karklin "National Fruit Crop Varieties of the Latvian S.S.R."

Moreover, in the Institute, a hybrid stock of apple, plum and cherry trees, numbering 3,000 plants, has been built up. The main purpose of creating this stock is to study the manifestation of hereditary characters and properties in hybrid progeny in relation to the original parent forms and conditions of nurture. Investigations have established an intimate relation between the genetic age of the variety, its geographical origin and ability to adapt to soil-climatic conditions and the degree to which its characters and properties are exhibited by the progeny. Of the hybrid plants studied three hybrid seedlings of the apple tree, four plums and three seedlings of the cherry tree have been picked out as promising. This research has been published in the collection "New Forms of Fruit-Berry Culture" and in a number of scientific papers.

Investigations begun in 1958 into the physiological and biochemical aspects of winter hardiness of fruit plants brought out a number of interesting patterns in the metabolism of plant varieties with and without winter hardiness. It was established that the oligosaccharides play an essential role in raising the resistance of plants to frost.

The results of study carried out in the gamma-ray field of the Institute of Biology of the effect of chronic, continuous ionizing radiation of plants on growth and development of productivity of the leading farm crops have demonstrated the positive effect of low (stimulatory) doses on productivity of the green mass and grains of maize, rye and wheat and potato yield. Single (acute) irradiation of the seeds of maize with gamma rays (results over a three-year period) showed that low doses of the order of 500 and 2000 r exerted a definite stimulatory effect on seed germination and plant productivity. High doses (8000, 6000 r) caused a marked fall in the germination of seeds, a sharp reduction in the rate of growth and development and also, decline in the productivity of the experimental maize. Cytological investigations have established a definite correlation between the irradiation doses and the intensity of the cell mitotic processes.

A study of the physiological effect of compounds with biological activity (maleic hydrazide, aminotriazole) in plants showed that the effect of these compounds is dependent on the concentration of the solution used and the phase of development of the plants when treated.

In pursuance of the resolution of the Council of Ministers of the Latvian S.S.R. the Republic's resources

of wild fruits, berries and edible fungi have been studied with resulting proposals for increased collections for the canning industry.

Much work has been done in study of the problem of the introduction and acclimatization of woody, bushy and herbaceous plants.

Members of the Institute of Biology and the Botanical Gardens of the Academy of Sciences of the Latvian S.S.R. have, during fieldwork, collected extensive material on spread, ecology, winter hardiness, biological and decorative features and seed productivity for all the main woody and bush varieties introduced into the Republic. The investigation revealed the origins of exotic plants, a list of which was submitted to the relevant organizations. In addition, by means of local enquiries and the compilation of circulars the effect of the exceptionally severe winter of 1955-1956 on the wintering of over 300 species and forms of foreign decorative varieties of trees and shrubs was studied.

The material collected on the introduction of woody and shrub varieties into the Latvian S.S.R. has been outlined in a number of popular scientific pamphlets and articles and also in the collected works "Introduction of Plants and Accumulation of Vegetation in the Latvian S.S.R.".

On the basis of many years' work with nut-bearing trees carried out in the conditions of the Moscow Region and continued since 1952 in Latvia, an outline has been compiled for ecological - physiological research into acclimatized nut-bearing plants, published in the form of a monograph ("Walnut, Its Introduction and Acclimatization in the U.S.S.R." by A. Ozols and Ye. Y. Khor'kov).

Considerable work has been done on the study of the species and variety composition of the grape in the Republic, production of new varieties of grape adjusted to local conditions and development of the basic method of agrotechnics of the vine on open and closed ground.

A study of a number of introduced herbaceous tannin-bearing plants has shown that in the conditions of the Latvian S.S.R. in terms of yield and content of tannides in their roots the most promising species for introduction into culture are taran tannin and Tsien-Chan dock. On the basis of the investigation, instructions have been prepared and published on the production testing of cultures of some herbaceous tannin-containing plants.

A study in the conditions of the Latvian S.S.R. of introduced lucerne (Tsien-Chan lucern) has shown that it is

a highly promising fodder plant.

A great deal of work has been done on a comprehensive experimental assessment and selection treatment of inter-species and inter-varietal hybrids of the potato grown by the plant breeder P. Knappe. The specimens best suited for production and selection requirements have been submitted for State variety testing and to the Priyekuli State Selection Station. The results of the investigation have been published in a pamphlet and a number of scientific articles.

The Institute is doing much work with michurinists of the Republic. This problem is the theme of two volumes published by the Institute "The Michurin Approach" and "Methodological Indications for Michurinish Horticulturists" and also a number of popular scientific pamphlets.

Investigations on zoology and parasitology have been chiefly concerned with the study of the biology of plant pests and human and animal parasites.

The plant pests studied include saw-flies, May bugs, June beetles, click beetles and pests of the onion, apple-tree and berry crops. As a result of these investigations methods have been worked out for combating these pests which are already being applied in practice. Material on the biology of saw-flies has been published in the monograph by J. Tsinovskiy "Insects of the Latvian S.S.R. - Uroceridae and Cephidae". The most dangerous polyphage pests in the conditions of the Latvian S.S.R. are May bugs. From a study of the biology of May bugs it is possible to work out effective measures for controlling this pest. The results of investigations of the May bug have been published in a separate monograph by J. Tsinovskiy "Biological Bases for Prognosis of Pupation of the Larvae of the May Bug."

The biology and parasitology of pests of fruit trees and shrubs have also been studied. Some species of parasites have been found which are of great importance in measures to combat the lesser apple worm, the apple moth and the apple fly weevil. *Trichogramma* have been most successfully used for the first time in Latvia for combating the fruit moth.

Among hydrofauna, water insects of the lakes have been investigated in detail. Reviews have been published on the production importance of the larvae of the lake chironomid and caddis fly fauna. In addition, the dragonfly fauna of the Republic have been investigated with the findings generalized in a monograph by Z. D. Spuris "Dragonflies of the Latvian S.S.R."

In order to work out methods of combating helminthosis widespread in man and farm animals, research into the helminth fauna has been going on since 1954. Field investigations have shed light on the helminth infestation of the population and the spread of the most important helminthoses of man and farm animals. Mass dehelminthization of the population in relation to ascaridosis has been carried out with application of the most modern drugs and methods of treatment (diathermy, oxygen, santonin with chenopodin oil and also preparations of piperazine).

Moniezia infestation has been thoroughly studied and on the basis of the results proposals made on the times for pre-imaginal dehelminthization.

The Oribatid tick fauna have been studied. Ninety species of Oribatidae have been recorded, of which 3 species are intermediary hosts of Moniezia. The proposals for prophylactic measures in the conditions of the Latvian S.S.R. for control of fascioliasis and moniezia infection and application of Shcherbovich's method in the diagnosis of worm infestation in humans have been introduced into practice.

One of the first tasks in ornithology was renew and continue the ringing of birds which is of great importance in establishing the routes of their migratory flight. Ornithologists of our Republic took part in 1958 in a concerted investigation of bird migration.

As a result of the investigation, the possibilities of using "hollow-nesters" - insect-eating birds - in the fight against forest pests were seen and proposals worked out which have been widely applied in forestry practice.

The importance of the conditions of nesting of divers has been elucidated which makes regulation of their numbers possible by changing these conditions. An effective method of control of foxes, raccoons and grey crow which prey on divers has been worked out by poisoning the eggs with luminal.

The results of work of the ornithological laboratory have been published in two volumes in the series "Ornithological investigations".

The Institute of Biology is doing much scientific work in connection with the reconstruction of the ichthyofauna of the inland waters of the Latvian S.S.R.

In accordance with the resolution of the Council of Ministers of the Latvian S.S.R., The Institute of Biology, together with the All-Union Institute of Lake and River Pisciculture and the Latvian State University have made a combined investigation into the 20 most important exploited

lakes with a total area of over 26,000 hectares. The measures for the reconstruction of the ichthyo-fauna worked out for the Latvian lakes studied made possible a plan for the future prospects for conversion of these lakes into fisheries.

Investigations at field stations have been carried out to obtain fuller information on the seasonal course of the food basis of the fish and ichthyo-fauna of the main typical exploited lakes (Dridza, Siver, Reznas and Usna).

It has been established that the pike has the fastest growth rate in the lakes of the Republic. The slowest growth is displayed by Blicca bjoerkna. In addition, two ecological forms of perch differing in rate of growth, habitats, times of spawning, feeding and also in colour, have been studied.

On the basis of the results of the investigation proposals have been worked out, the implementation of which will ensure the provision of reserves of fish of economic value. The proposals of the Institute of Biology have also been taken into account in drawing up the rules of pisciculture.

Investigations into the acclimatization of white fish in the waters of the Latvian S.S.R. have established that in ponds white fish can be reared both in the form of a monoculture and in the form of a polyculture - together with carp, crucians and other fish. White fish is a rapidly-developing fish well adapted to lakes and can be recommended for stocking the lakes of the Republic.

The composition of the parasitic fauna of lake and pond fish has also been studied. On the basis of the results a whole number of recommendations have been made for the fish industry on the prevention of the spread of diseases of fish.

Hydrobiological investigations of the waters of the lower course of the rivers Daugava and Liyelupe and also Lake Kish have shown that there is now an acute need for the installation of new improved systems of purification and detoxication of sewage from the town of Riga and in the district of the Riga beach. A number of books and collected works have been published on hydrobiology.

In the sphere of animal physiology the Institute of Biology, after taking over this subject, continued the work initiated in the Institute of Zootechnics and Zoo Hygiene aimed at clarifying the biological role of micro-components (trace elements, vitamins and antibiotics) in the feeding of farm animals. The content of trace elements and vitamins in the organs of domestic animals, milk and

eggs has also been determined. The results of the investigations have made it possible to put into practice valuable proposals for animal husbandry relating to the use of trace elements, vitamins and antibiotics in the feeding of domestic animals. In the Republic work is now in hand for the production of new vitamin and antibiotic preparations (fodder biomycin, irradiated yeast, mycelia - the waste products of penicillin and citric acid - flour of acerose leaf, furazolidone, etc.). Applying the results of research, the Riga Fodder Combine as from 1958 has been producing feeds enriched with trace elements, vitamins and antibiotics. These combined feeds have given highly economical results in the collective and state farms of the Republic.

Together with solving practical problems in this sector, important investigations have been carried out i. a study of the absorption and utilization of calcium and other mineral substances in the body of fowl.

During an investigation of the possibility of reducing the riboflavin deficit in feeds, effective methods of yeasting were found which make it possible to bring about a substantial increase in the content of riboflavin in the feeds; new feeds enriched with it have been studied. A relationship has been established between riboflavin and vitamin B<sub>12</sub>. It has been found that in the presence of riboflavin, vitamin B<sub>12</sub> is better utilized and accumulates in the body.

It has been established that it is possible to reduce considerably the animal protein requirement of chicks and piglets by the simultaneous inclusion in their rations of vitamin B<sub>12</sub>, riboflavin and antibiotics. The optimum ratios of these trace factors in the ration have been established.

The results of research into animal physiology have been published in the monograph by A.R. Valdman "Significance of Vitamins in Nutrition of Farm Animals and Birds" and in six other monographs and books.

The Botanical Gardens of the Academy of Sciences of the Latvian S.S.R. were set up in 1956 at the site of the former Salaspils Experimental Station for Ornamental Horticulture covering 130 hectares. The task of the new Botanical Gardens was to conduct research into problems of flora and plant life, genetics and selection, introduction and acclimatization of plants, ornamental horticulture, useful properties of plants, greenery in towns, populated

areas and collective farm centers, etc. It may be said that the Botanical Gardens with the rich collections of plants and laboratories will become a key center of experimental botanical research in the Republic.

The team of scientific workers at the Gardens, as well as developing project assignments and the plan for the construction of the botanical garden, has done much work in gathering collections of plants and organizing the Library. At the present time in the collections and exhibitions of the Gardens there are 7,269 names of useful plants, including 3,176 names of open-ground, woody and bushy plants and 83 herbaceous plants. As a result of selection work with decorative plants (gladiolus, delphinium, roses, tulips) a number of promising hybrids of gladioli and delphinium have been selected and sent for state variety testing. Methods have been devised for the accelerated multiplication of the most valuable forms of ornamental coniferous plants. A list of ornamental plants has been drawn up and submitted to the Institute for Building and Architecture of the Academy of Sciences of the Latvian S.S.R., as plants recommended for beautifying the residential areas of towns. At the Botanical Gardens, the State Commission of the Latvian S.S.R. has been set up for variety testing and establishing copyrights on new varieties of floral and decorative plants (with the State Variety Division for Decorative Plants) which tests and assesses the new forms and varieties of decorative plants cultivated by plant breeders of the Republic. Furthermore, at the Gardens a Republic quarantine laboratory and quarantine some have been formed.

The Botanical Gardens lead and coordinate the Republic scientific research in the sphere of introducing plants and ornamental horticulture. Expeditions by the staff of the Gardens have examined 647 parks of the Republic in which over 600 species of decorative plants have been listed, some species being discovered for the first time. All these species are grown in the Botanical Gardens. During the work precursors of decorative woody plants have been selected in order to obtain a local seed material for building up green reserves. The results have been outlined in a number of pamphlets and articles.

The Botanical Gardens maintain a close link with many botanical gardens and scientific institutes of the U.S.S.R. and foreign countries. Exchange of seeds has considerably supplemented the collection of the Gardens with new species and plant forms.

The laboratory for plant protection is working out

new methods for the protection of decorative plants against pests. In particular, the laboratory has devised a method for controlling tree aphids by means of intercation belts. The laboratory of biochemistry and physiology has initiated research into the effect of radioactive radiations on productivity, biochemical composition and physiological processes of individual cultivated plants and also research into the effect of various vitamins and antibiotics on productivity and improvement of the chemical composition of cultivated plants.

The Botanical Gardens maintain a close link with organizations working in the sphere of green plant production and also specialists and michurinists of the Republic. In a relatively short period (three years) it has succeeded in constructing five hothouses with central heating and piped water supply and extensively repairing a further five hothouses. A nursery with an area of ten acres has been started where the most promising decorative plants are grown. Already over 235,500 trees and shrubs, herbaceous and floral plants and bulbs have been handed over to production organizations.

On the basis of the reconstruction of a number of farm buildings, temporary laboratories and workrooms for scientific staff have been set up. Three dwellings have been built. In addition, work has begun on the building of a garage, hothouse, vegetation house and a number of other premises.

#### Institute of Microbiology.

In the Institute valuable theoretical and practical results have been achieved on agricultural microbiology which have contributed to the rise in soil fertility and the yield of agricultural crops.

Investigations have been undertaken to shed light on the microbiological aspects of various types of soils in the Latvian S.S.R. Changes in the soil microflora as a result of cultivation in the soil have been established.

In the study of interrelations of the individual races of nodule bacteria in the soil and in the rhizosphere of plants it has been established that the take of nodule bacteria applied in the soil in clover roots and the formation of nodules largely depends on the ability of the particular race to multiply in the plant rhizosphere and on the root surface. Accordingly, the effectiveness of nitragin fertilizer depends on the take (invasion) and virulence and on the ability of the bacteria introduced with the nitragin to fix atmospheric nitrogen.

Of the large number of races of nodule bacteria of

clover some have been obtained which, when introduced into the soil with the seed, are capable of dominating the less active but virulent, freely living nodule bacteria in the soil. These races gave 60 - 100 per cent of the total number of nodules and raised the clover yield 10 - 15 per cent.

Investigations of the effect of trace elements on virulence and activity of nodule bacteria has established that trace elements (boron, molybdenum) increase the number of such bacteria in the soil and the rhizosphere of plants and also the yield of tuber plants. These trace elements also raise the content of nitrogen in tuber plants. The effect of trace elements on the activity and numbers of Azotobacter in the soil has also been studied. It has been established that introduction into the soil of manganese copper and zinc, or spraying of plants with salts of these trace elements increases the numbers of soil Azotobacter. These trace elements in the local strain (No. 48) of Azotobacter raised nitrogen binding.

Investigations have established that in all the soils of the Republic examined phosphorus bacteria are widespread and therefore the application in the Latvian S.S.R. of the bacterial preparation - phosphorobacterin - is pointless.

In the sphere of technical microbiology, investigations have been carried out on the rationalization of the fermentative processes of fruit-berry wines, the physiology of bacteria-destroying malic acid, the spread of Lactobacillus in the epiphyte microflora of plants and also physiological and morphological properties of these bacteria. The vitamin B<sub>12</sub> content of milk in the Latvian S.S.R. has been studied. Research has been done on the spread of Mycobacterium tuberculosis in milk and on defining its role in the aetiology of human tuberculosis.

Recently, special attention has been paid to investigations of the aetiology of diseases of the respiratory tract in swine. For some years the institute has made a study of the ability of microorganisms to synthesize vitamins and also the role of microorganisms in providing the human and animal body with vitamins. It has been shown that nearly all the representatives of the aerobic intestinal flora of man and animals take part in biosynthesis of vitamin B<sub>6</sub> and B<sub>12</sub>. It has been demonstrated that the physiological biosynthesis of vitamins is depressed by antibacterial preparations given orally. As a result of this work practical conclusions have been drawn on the rational use of antibacterial preparations and the

significance of the right nutrition for maintaining the normal intestinal flora (E.J. Kaley, etc.).

The results obtained show that when using antibacterial preparations it is necessary at the same time to provide the body with vitamins.

In recent years research has been started on the biosynthesis of vitamins of the anaerobic intestinal flora and the relation between biosynthesis and nutritional factors.

A conspicuous place in the research work of the Institute is occupied by study of changes in the morphology of microorganisms under the influence of factors of the external environment. Of interest are the investigations into the atypical and filtrable forms of *M. tuberculosis* and their role in the pathogenesis of tuberculosis. These investigations were the sequel to those initiated in 1913 by A.M. Kirhenstein on bacterial structure. Investigations have shown that under definite conditions, from the granular form typical tuberculosis rods are produced with new biological properties and raised pathogenicity. By using a large number of animals it has been established experimentally that this process proceeds in the infected body under the influence of unfavorable factors of the external environment (low nutrition, mixed infection, etc.). This work is of great theoretical and practical importance for the prophylaxis of tuberculosis.

In conjunction with the Institute of Geology of the Academy of Sciences of the Latvian S.S.R. a comprehensive study has been made of the composition and properties of the microflora of sulfur waters and their significance in the formation of the Kemeru sulfur waters. As a result of the investigation, concrete proposals have been worked out for the preservation of the sulfur waters of Kemeru.

In recent years the composition and physiological properties of the sapropels of Lakes Kemeru, Babite, etc. have been studied. The ability of individual groups of sapropel microorganisms to synthesize vitamins has been determined and also the possibilities of stimulating biosynthetic properties studied. These investigations are of great importance in exploring the possibilities of using sapropel muds in medicine.

A large place in the work of the Institute is taken up by the problem "investigation of the importance of the reactivity of the microorganism in immunological processes". All the investigations carried out within this context have been directed at developing prophylactic measures against infectious diseases. During many years the Institute of

Microbiology has studied the effect of the factors of nutrition especially vitamins, on the natural and acquired insusceptibility of the body to infectious diseases.

In the study of the essence of microbial virulence it has been found that in the genesis and course of infection a decisive role is played by the physiological reactivity of the body and not by the properties of the microbe, including its virulence. A whole series of experiments has demonstrated the importance of vitamin C in maintenance of immunity. The role of vitamin C in raising the effectiveness of vaccination has been established with the resulting need for rationalization of the existing vaccination techniques. On the basis of the research, practical proposals have been worked out and submitted to the Ministry of Health of the Latvian S.S.R.

Particularly great attention in relation to this problem has been paid to prophylaxis of tuberculosis, which is of great importance in the conditions of the Latvian S.S.R. Factors exerting an influence on immunity and allergy in tuberculosis have been studied. Attention has been focused on the investigation of the nutritional factors which provide the body with increased resistance to tuberculosis and delay the conversion of latent to clinical infection; the link between tuberculosis and allergy, mixed infection tuberculosis, the problem of BCG vaccination and the conditions determining the level of immunity to tuberculosis have been studied.

In the Institute an ultrasonic apparatus has been designed for the irradiation of microorganisms; this makes it possible to analyze the effect of ultra-sound on microbes. Irradiation of the tuberculosis vaccine for several seconds with low intensity ultra-sound improves the allergic and immunogenic properties of the vaccine. Similar treatment with ultra-sound raises the pathogenicity of *M. tuberculosis*. With use of the isotope method the fate in the animal body of *M. tuberculosis* labeled with  $^{32}P$  has been studied experimentally. It has been shown that there are far fewer microbes in the body of vaccinated animals and they disintergrate more rapidly than in non-vaccinated animals (E. M. Planders and I. V. Skards).

The significance of vitamins and immunobiological processes of the body has been studied in experimental *Leptospira* infection. Attention in this work was centered on the effect of vitamins C, P and K on capillary resistance and also on humoral and cell protective systems.

Of great importance are the investigations of the physiological functions of the normal intestinal flora. In

the Institute the composition and properties of the intestinal flora of children have been investigated at various periods of the year. It was found that in the spring, manifestations of intestinal dysbacteriosis were noted, i.e. change in the composition of the microflora. Administration of vitamins improves the composition of the microflora. On the basis of the results, recommendations have been worked out for the prophylaxis of dysentery (M.K. Indulen and others).

In recent years a significant place in research has been occupied by investigation in the field of virology. In 1956 a virological laboratory was formed for the purpose of studying the aetiology of poliomyelitis in Latvia. In the Institute a great deal of work has been done in the isolation and typing of the poliomyelitis viruses in patients. In Latvia all three types of poliomyelitis virus are encountered. However, most of the strains isolated belonged to type I. At the same time, it has been noted that the considerable proportion of the cytopathogenic viruses isolated are not related to the poliomyelitis virus. In subsequent work an important stage was the study of these viruses which was along two lines:

(1) determination of the aetiological role of these viruses in diseases diagnosed as paralytic poliomyelitis and serous meningitis.

(2) study of the spread of enteroviruses amongst the population of the Republic especially among children of various age groups.

The results show that among healthy children enteric viruses are isolated comparatively often (15 - 18 per cent). In children with various intestinal disorders enteroviruses are isolated considerably more frequently (35 per cent). The role of ECHO-9 virus has also been demonstrated in the aetiology of aseptic serous meningitis. Together with virological investigations, the epidemiology of poliomyelitis has been studied. From a general review of the incidence of poliomyelitis in Latvia in the last 30 years the epidemiological pattern of this disease in the Republic has been established.

Serological investigations have also been undertaken. The immunostructure of the population before vaccination against poliomyelitis and the duration of vaccinal immunity after immunization by the method of Salk have been studied.

Of great importance is the study of the effectiveness of the live attenuated poliomyelitis vaccine. These investigations are designed to make epidemiological, virological and serological study of the live vaccine. The

work has been done in conjunction with the staff of the Ministry of Health and the Virological Laboratory of the Republic Public Health-Epidemiological Station. The course of multiplication of the vaccine virus in the intestinal canal of inoculated persons and their contacts has been studied in detail. Of definite interest are the investigations on the spread of vaccine virus in family foci.

These investigations are the first stage in a wide study of the fate of the vaccine virus in the external environment. Serological investigations show that as a result of immunization with the live vaccine there was a considerable rise in the antibody titer in those vaccinated. The results of the epidemiological study show that the new preparation - live attenuated vaccine - is highly effective and completely safe in mass use (R.A. Kukainis and others).

The convincing results obtained show that the new means for specific prophylaxis of poliomyelitis is very promising and will make it possible completely to eradicate poliomyelitis in the Republic.

The Institute of Experimental Medicine was formed in January 1951 as a result of the reorganization of the Institute of Biology and Experimental Medicine and the Institute of Nutrition. The main problems tackled by the Institute are health resort matters, metabolism and nutrition, tuberculosis, oncology, testing of new therapeutic substances and regional pathology (endemic goitre, rheumatism). The Institute has also the job of popularizing the achievements of medicine and the application of the results of its research in the health service.

In health resort science, the Institute has studied the problems of rational use of the therapeutic factors of the Kemeru, Baldone and the Riga Beach health resorts with the result that a number of important aspects of the mechanism of the therapeutic effect of these factors of direct practical importance have been established.

A series of investigations has been concerned with the effect of hydrogen sulfide baths and mud applications in the treatment of patients with arthritis, radiculitis and endarteritis.

The physiological and biochemical factors of the effectiveness of treatment of chronic sciatica at the Kemeru resorts have been studied and also the effect of health resort treatment on conditioned-reflex activity in children with chronic polyarthritis and poliomyelitis sequelae.

The findings obtained make it possible to look anew at the problem of proper dosage and the concentration

and duration of hydrogen sulfide baths in the treatment of these diseases.

The effect of artificial and natural negative aero-ionization on the course of hypertonic disease has been studied in the Riga seaside resort. It has been shown that the most important climatic factor of the resort is negative ionization of the air. Artificial ionization for inpatients has been given by means of the aero-ionizers designed in the Institute which have been introduced into clinical practice (F.G. Portnov). The therapeutic properties of the waters of Barbel, Adamovo, Kapsiave and Valmiers have been investigated.

Instructions have been issued for medical practitioners on the most rational use of local health resort factors in the treatment of patients.

Over a number of years the Institute has been concerned with study of the physiological bases of rational nutrition of the healthy and sick individual (A.A. Shmidt and others). Work has been done in two directions - defining the individual technological processes of producing a vitaminized protein preparation and studying its action on the living body. During work on the preparation, an experimental vitamin factory of the Academy of Sciences of the Latvian S.S.R. was built and nutritive yeast introduced with high accumulation of organically bound cobalt, copper and manganese. The technology of producing yeast cheese has been mastered. In addition, combined work has been done in studying disturbances in metabolism of the animal and human body exposed to ionizing radiation and the role of the nutritional factor in their prevention.

A series of investigations has been carried out on the problem of cancer. Secretory, motor and certain other changes in cancer and precancerous states of the stomach have been studied. A series of investigations has been undertaken on haemopoiesis in cancer and precancer of the stomach. An apparatus - electrogastrograph - has been designed for recording the biocurrents of the stomach and the bioclectric potentials of the stomach in cancer and precancer has been studied.

The pathophysiological and biochemical changes in cancer have been studied (coagulation basin, catalase activity, adrenergic and cholinergic substances and neuro-vegetative substances in the blood in relation to treatment and the excretory function of the pancreas in cancer and precancer).

In the study of nutritional problems of patients with cancer, schedules of optimum feeding in the pre-and

post-operative periods have been devised (K.A. Skulme).

In 1959 work in the field of oncology was extended and pursued more thoroughly (P.J. Gerke, V.M. Bramberg etc). Scientific workers of the Institute numbering 18, have concentrated on the solving of this problem. In the Republic Clinical Hospital a chemotherapeutic department has been opened at which work on oncology is being developed in collaboration with medical practitioners.

As for tuberculosis, a study has been made of new surgical methods in the treatment of lung and bone-joint tuberculosis. In the chemo- and diet therapy of tuberculosis, a clinical evaluation has been made of the effect of paraamino salicylic acid, benzazone, phthiazide, tubazide and preparation "22".

In the prophylaxis of tuberculosis, work has been done on vaccination against tuberculosis with BCG in children both in Riga and other districts. In particular, the Vilyane district of Latvia has been selectively investigated.

Morphological and physiological work has been done (a) on the cytology of the gastric mucosa in cancer; (b) on the innervation of the human stomach in normal patients and persons with ulcers and cancer. Receptors of the pylorus and the duodenum in man in the normal state and neutralization of the human suparenals have been studied. The features of development of the lymph nodes in foetuses and newborn have also been studied.

In the field of physiology, the course of third order waves in the sphygmoplethysmography in man, in normal conditions and with vascular disorders, and also the role of the peripheral and central nervous system in the origin of disturbed vascular reactions have been studied.

To extend research into rheumatic fever and diseases of the cardiovascular system the Institute has set up a department of clinical physiology and therapy. The department will study the role of the connective tissue and the endocrinial system in the pathogenesis of cardiovascular disorders. In connection with the problems of regional pathology of the Latvian S.S.R. investigations have been carried out with the application of radioactive iodine in the therapy of thyrotoxicosis.

A number of scientific themes have been developed outside the framework of the Institute with the cooperation of medical practitioners and other specialists (biologists, chemists, technologists), working as corresponding scientific colleagues. This has helped to extend

research and to apply the results of the work of the Institute in therapeutic institutions.

The Institute has cooperated on two themes with the Academy of Sciences of the Rumanian People's Republic and in particular, with the Parkhen Institute of Geriatrics on problems of aerosol ionization of pulmonary diseases.

Apparatus for this new form of treatment has been jointly devised and applied.

Between 1953 and 1960 at the scientific council of the Institute 68 candidature dissertations were defended. The Institute has issued five monographs, over 20 collections of scientific works and a number of popular scientific pamphlets.

The results achieved by the biological and medical institutes of the Academy of Sciences of the Latvian S.S.R. are a serious contribution to the science of our Republic.

## MICROBIOLOGY DURING SOVIET LATVIA'S TWENTY YEARS

by A. Kirhenstein

pages 147-152

The flourishing of microbiology in Soviet Latvia is closely associated with the Soviet regime. Simultaneously with the founding of the Academy of Sciences in 1947 the Institute of Microbiology was also established and has become the center for microbiological research.

During the first days of its existence the Institute of Microbiology evolved an extensive and far-reaching plan for research work. In the field of medicine this plan and later work paid direct attention mainly to problems of prophylaxis of infectious diseases.

The scientific-research work in the field of microbiology has been done mainly in three directions. The physiology and morphology of microorganisms and, later, also that of viruses have been studied; extensive studies have been conducted in elucidating the significance of the reaction of the organism in immunobiological processes; and, finally, the interrelationships of the higher plants and microorganisms have been studied. The research in these directions has encompassed all of the main branches of microbiology, general microbiology, medicinal and veterinary-medicinal microbiology and virology, agricultural and technical microbiology.

The first part of this research was associated with innovations in the production of vaccines and serums, and an important part of it was devoted to studies on the stimulating influence of vitamins on the growth, development, and metabolism of microorganisms.

Several studies have been completed in the elucidation of the significance of physical factors in the development and metabolism of



microorganisms. The ultrasonic generator built by the Institute of Microbiology enabled studies to be made of the influence of ultrasonic waves on the physiological and morphological properties of microorganisms. These studies were devoted also to the clarification of the mechanism of the influence of ultrasonic waves.

A great number of studies were conducted on the ability of microorganisms to synthesize vitamins, and especially on the role of microorganisms in supplying man and animals with vitamins. In the intestinal tract of man and animals, as was shown by the results obtained, the microorganisms synthesize most of the vitamins of the B-group. Moreover, it was found that under the influence of various circumstances the biosynthesis of vitamins accomplished by the microorganisms is disturbed or even inhibited. Anti-bacterial preparations, as well as some other drugs, when introduced into the organism change the normal microflora of the human and animal intestines, and in some individual cases the microflora is completely lost. Thus, a deficiency of vitamins of the B-group in the organism is brought about.

Based on the results obtained in these studies, practical conclusions have been made on the application of anti-bacterial preparations and the significance of proper diet in the preservation of normal intestinal microflora. It has been proved experimentally that when anti-bacterial preparations are used in medicine, especially when used over a long period of time, serious health problems develop. Therefore, their use must be discontinued, and the organism must be supplied a wholesome diet, rich in vitamins. Studies on vitamin biosynthesis by the anaerobic intestinal microflora dependent on diet factors of the organism have been started.

Studies of the changes in the morphology of microorganisms under the influence of factors of the external medium are of considerable significance. The comparative method was used in the research work on the morphology of microorganisms using an ordinary microscope, phase contrast, fluorescence, and an electron microscope. Thus, it was possible to come to a number of conclusions on the structure of some microorganisms (the lactic acid bacterium, the intestinal rod, and others).

Important is the research on the atypical and noncellular forms of mycobacterium tuberculosis and their role in the pathogenesis of tuberculosis. It has been found that under some circumstances typical tuberculosis rods with new biological properties and increased pathogenicity are formed from the granular forms. This research is of a great theoretical and practical significance in the prophylaxis of

tuberculosis.

Of theoretical and practical significance is the research on the composition and physiological properties of the microflora of the sulfur waters at the Kemerī and Baldone springs. The qualitative composition of the sulfur bacteria in different seasons has been investigated. During these investigations a new species of thiobacteria was isolated from the Kemerī sulfur waters and described. The composition and properties of the microflora of sulfur water and their significance in the origination of the Kemerī sulfur waters has been thoroughly investigated.

During recent years the composition and physiological properties of sapropel microflora in Lake Kemerī and Lake Babite have been investigated. The vitamin-biosynthesis abilities of the individual microorganism groups encountered in the sapropel have also been studied and ways to stimulate these biosynthetical properties have been sought. This research has significance in clarifying the feasibility of medicinal application of sapropel mud.

Several investigations have been devoted to milk product fermentation processes in which the main attention has been paid to the study of the biosynthesis ability of the lactic acid bacteria. In the studies on vitamin B<sub>12</sub> content in milk in the Latvian SSR it has been found that the B<sub>12</sub> content in milk is dependent on cobalt content in the feed. Methods for determination of vitamin B<sub>12</sub> in milk have developed.

Of considerable significance in research in the field of medicinal microbiology is the problem "Studies on the significance of the reactivity of the macroorganism in immunobiological processes." The work within the scope of this problem has been directed toward development of prophylactic undertakings in the fight against infectious diseases.

Studies on the influence of diet factors, especially the influence of vitamins on the natural and acquired immunity against infectious diseases, have been carried on for several years at the Institute of Microbiology.

The first studies (1946 - 1947) on the problem of the essence of microbe virulence have already established that the physiological reactivity of the organism and not the properties and the virulence the microbes are of decisive significance in the origination of the infection process and its progress. Numerous series of experiments proved the significance of vitamin C in the preservation of immunity.

These studies proved that in the prophylaxis of infections during the winter and spring period vitamin treatment is required, especially that of vitamin C. For further testing and to introduce such treatment into practice the Institute of Microbiology organized vitamin treatments for workers at some industrial enterprises in order to decrease the number of persons that become diseased with the so-called "cold". The significance of a wholesome, vitamin-rich diet in scarlet fever prophylaxis, development and therapy was also clarified. Moreover, the results obtained show that when sufficient doses of ascorbic acid are introduced into organisms of children it is possible to increase the defensive abilities of the organism against scarlet fever.

The significance of vitamin-C in the increase of the electivity of vaccination was clarified resulting in the necessity to make innovations in the existing human and animal vaccination methods. Experimental results showed that as a result of vaccination an increase in the use of vitamin C reserves in the organism occurs and, therefore, the reactivity of the organism is decreased. Practical recommendations on the vaccination innovations have been submitted as a result of these studies.

Some work has also been done in the clarification of the complementary activity of blood serum in various infectious diseases. Complementary activity, which is one of the factors of natural immunity, decreases in various infectious diseases (typhoid fever, dysentery, typhus fever, enterocolitis). It is possible to increase the complementary activity of blood by introducing vitamins B<sub>1</sub> and C into the organism.

In solving this problem special attention has been devoted to the problem of tuberculosis prophylaxis, which is of important significance under the existing circumstances in the Latvian SSR. Studies have been conducted on the circumstances that influence the immunity and allergy toward tuberculosis. The main attention has been devoted to the problems of those diet factors which increase the resistance of the organism against tuberculosis and prevent the infection to turn into disease; the association of tuberculosis and allergy in the cases of mixed tuberculosis infections; BCG vaccination; and circumstances which determine the degree of immunity against tuberculosis, and others.

Experimental studies show that vitamin C is of important significance in the immunobiological processes of tuberculosis. It has been found that in animals which do not synthesize vitamin C and whose diet does not contain this vitamin the immunity after the BCG vaccination does not produce anti-tuberculosis vaccine germs, which circumstance under normal conditions is quite harmless, but in C-hypovita-

minous animals it can bring about tuberculous changes in the internal organs, including tissue disintegration. Hypovitaminous animals can become diseased with tuberculosis both after subcutaneous and internal introduction of the BCG vaccine.

It has been found that vitamin C deficiency promotes the turning of a latent tuberculous infection into disease. Infection of C-hypo-vitaminous and scurvy-suffering animals with the filterable forms of the mycobacterium tuberculosis sometimes causes the animal to become diseased with tuberculosis, which never happens to animals that have received a wholesome diet.

These observations give evidence that in an organism in which the immunobiological reactivity is disturbed, a transformation of the tuberculosis-causing filterable and granular forms into typical mycobacteria tuberculosis takes place, which causes disease in organisms that are not able to resist it.

Studies have been conducted on the adverse influence of anti-bacterial therapy on vitamin C supplies in a tuberculous organism. Taking into consideration the fact that the process of tuberculosis itself sharply decreases vitamin C reserves in the diseased organism, the necessity of vitamin C treatment of tuberculosis patients during anti-bacterial therapy becomes understandable.

The influence of a few other diet factors on the immunobiological processes of tuberculosis have also been studied. It has been found that the resistance of the organism against tuberculous infection is lowered by the deficiency of lipotropic factors, and partly also that of choline and folic acid. Addition of vitamin P in the form of tannin of tea to the animal diet, however, does not inhibit the development of the process of tuberculosis.

Ultrasonic homogenization methods for the determination of mycobacteria tuberculosis in the saliva of the diseased animals and infected milk have been developed. Using these methods an improvement in the diagnostics of tuberculosis has been achieved, since they give better results than the laboratory diagnosis methods used heretofore.

In theoretical studies the main attention has been devoted to the short-term influence of ultrasonic waves on microorganisms. It has been found that a short-term ultrasonic wave treatment of microbes promotes their reproductive abilities and biochemical processes.

Using the isotope method the fate of mycobacteria tuberculosis labeled with  $P^{32}$  in the organism of the experimental animal has been

investigated. It has been found that the dispersion of the germs in the organism of the vaccinated animal is much less extensive and their decomposition is much faster than in the non-vaccinated animal.

It has been established that the defensive reactions of the animal, mainly phagocytosis, is influenced by the surface properties of the mycobacteria tuberculosis, for example, their electric charge. Bacterial cells carrying a negative charge are phagocytized to a lesser extent and their pathogenic properties are more pronounced than those of electroneutral cells. Studies on the significance of the cellular surface of mycobacteria tuberculosis in the infection process are being continued.

The significance of vitamins in the immunobiological processes has been investigated also for experimental lepto spiroses.

Of important significance is the research on the physiological functions of the normal intestinal microflora. In the pathogenesis of dysentery more and more significance is being ascribed to the condition of the intestinal microflora. In this direction the contents of the intestinal microflora and its biological properties in babies during the different seasons of the year have been investigated. It has been found that during the spring period changes in the biological properties of the normal intestinal microflora can be observed in very many cases. These studies have also established that in the spring the phenomenon of disbacteriosis is observed. Vitamin treatment improves the composition of the microflora. On the basis of the results obtained a recommendation on dysentery prophylaxis for children has been worked out.

Several studies have been accomplished in the direction of development of undertakings of prophylaxis for domestic animals and birds. Statistical material has been processed and analyzed on the occurrence of tuberculosis in domestic animals and birds in the Latvian SSR.

It has been found that the number of domestic animals and birds which react to tuberculin varies from season to season. During the spring, the least number of domestic animals and birds which react positively toward tuberculin is observed. It has been established that the addition of yeast and conifer needles to their feed hinders the development process of tuberculosis in birds. The occurrence of tuberculosis bacteria in milk has also been investigated and studies have been made on the significance of the bovine tuberculosis germs in causing tuberculosis in humans.

During recent years extensive studies have been initiated on

infectious diseases in domestic animals. Special attention has been devoted to the clarification of the origins of infectious diseases in the respiratory organs of swine.

During recent years, in scientific-research work, a prominent place has been occupied by studies in the field of virology. In 1956, a virology laboratory was established at the Medicinal Microbiology Sector and was given the task of studying the etiology of poliomyelitis in our republic.

In the Latvian territory over a period of several decades, each year tens of poliomyelitis cases are registered. During epidemics several hundred persons become diseased periodically. Due to lack of data on the epidemiological and etiological peculiarities in our republic it was impossible to use effective prophylaxis undertakings. Thus, the development of virology in the Latvian SSR is closely associated with the resolution of the important problem of guarding the public health in the republic.

Beginning with 1956, extensive work has been done at the Institute in isolating and typing of the poliomyelitis virus from patients. As a result of this work it was found that all three types of poliomyelitis virus occur in the republic. Simultaneously it was established that together with the poliomyelitis viruses to be typed considerable amounts of other cytopathogenic viruses were obtained.

Beginning with 1959, simultaneously with virological research, a study of the epidemiology of poliomyelitis has been accomplished. This study, by generalizing the materials on the occurrence of poliomyelitis in Latvia during the last thirty years, has established the epidemiological peculiarities of this disease in the republic. This work is of great significance in the organization of undertakings for the fight against poliomyelitis. Of considerable importance in the virological studies done in the republic is the work done on the effectiveness of the weakened living poliomyelitis vaccine. These studies were begun in 1959. The studies were made in several directions, the most important of which are the virological, serological, and epidemiological investigations of the new preparation. These studies were made by the collective of virologists of the Institute of Microbiology in direct collaboration with the Anti-Poliomyelitis Service of the Public Health Offices of the Republic and the staff of the Virology Laboratory of the Republican Sanitary-Epidemiological Station. The dynamics of reproduction of the weakened living viruses of the vaccine in the intestinal tract of the persons vaccinated has been thoroughly investigated. As a result of extensive investigations, the dynamics of the increase of the antibodies that neutralize viruses in the blood

of vaccinated children has been elucidated. In this field a general analysis of the immunobiological situation of the population of the republic in respect to the poliomyelitis virus has been performed. The results of these studies show convincingly that the new poliomyelitis prophylaxis preparation is, without any doubt, effective and absolutely harmless in mass applications. As a result of the virological, serological, and epidemiological studies done by the virologists of the Institute of Microbiology, together with practicing doctors, extensive material has been gathered which indicates that the application of the new specific means of poliomyelitis prophylaxis has a promising future and that there are sure possibilities for the complete extermination of poliomyelitis in the republic.

Simultaneously with the direct research work at the Virology Sector of the Institute, problems associated with improvement of research methods, substitution of the expensive, deficit import ingredients for media, and others, as a result of which several domestic preparates have been successfully introduced in practical work that has been conducted continuously.

In the field of virology, as a result of the work done, opportunities have been created for extensive and thorough investigations of human and animal diseases caused by viruses and also for research on the etiology of malignant growths.

With deep satisfaction the collective of medicinal microbiologists and virologists received the resolution of the Central Committee of the Communist Party of the Soviet Union and the Council of Ministers of the USSR on the further improvement of the medical service for the populace of the USSR. Discussing this resolution at an expanded session of the Scientific Council of the Institute of Microbiology, concrete tasks for the collective of virologists and microbiologists of the Institute were worked out in the field of extermination of infectious diseases during the present Seven-Year Plan period. The above resolution stresses exactly the significance of prophylactic undertakings in the fight against diseases. It is evident from the work and publications of the Institute of Microbiology that we have always defended this position.

In the field of technical microbiology, a method for growing pure cultures of beer and wine yeasts for laboratories and industry has been worked out. Possibilities to improve the production process of fruit and berry wines have been studied and a method for the evaluation of these wines has been developed. The malic acid decomposition process in fruit and berry wines as well as the physiological properties of bacteria that decompose malic acid have been studied. Individual

studies have been devoted to the investigation of the epiphytic microflora and the physiological properties of lactic acid bacteria suitable in fermentation.

Extensive work has been done in the field of agricultural microbiology, the main task of which is to increase the fertility of the soil and the productivity of agricultural plants.

Research workers in this field of microbiology have investigated the microbiological peculiarities of the various soil types in the Latvian SSR and the changes in the soil microflora that result from cultivation; the occurrence of microorganisms which are used in the preparation of bacterial fertilizers has been investigated; the microbiological characterization of soil types in the Latvian SSR has been prepared. Serious consideration has been given to the investigation of the physiological properties of the soil microorganisms.

Of important significance are the studies on the interrelationships of the microorganisms of plant rhizosphere and the studies on the relationships of these microorganisms to the plants.

In the studies on the interrelationships of the races of clover nodule bacteria in the soil and rhizosphere of plants factors have been found which determine the thriving of the nodule bacteria introduced into the soil on clover roots. It has been established that the nitrogen-fixing effectivity is dependent on the thriving ability of nitrogen-fixing nodule bacteria, their infecting ability and their nitrogen-fixing activity. Examining the interrelationships of the races of the clover nodule bacteria in respect to the wild nodule bacteria that exist in the soil, races have been found which when introduced into the soil together with seeds are able to dominate the wild, low-activity, but virulent nodule bacteria, give from 60 to 100 per cent of the number of nodules and increase the clover crops by 10 to 15 per cent.

In investigating the interrelationships of soil microorganisms, it has been established that microorganisms occur in the soil and in the rhizosphere of plants which can either further or inhibit the growth of nodule bacteria. Factors of the external medium, which to a considerable degree influence the interrelationships of the nodule bacteria and the soil microorganisms have been clarified. One of such factors is the surface fertilization of natural grasses which increases both the number of nodule bacteria and the nodule bacteria activators. It has been established that the trace elements boron and molybdenum increase the number of nodule bacteria in the soil and the plant rhizosphere and also increase the productivity of legumes. In the presence

of these trace elements the nitrogen content in legumes also increases.

It has been found that trace elements also influence the amount of azotobacter in the soil. The introduction of trace elements manganese, copper, and zinc into the soil or the spraying of plants with salts of these elements increases the amount of azotobacter in the soil. The presence of trace elements has also increased the nitrogen-fixing activity of individual stems of the local azotobacter. Studies on phosphorus bacteria and on the interrelationships of the higher plants have established that phosphorus bacteria are found in all soils that have been investigated.

Of important significance is the work on the feasibility of bacterization of treated seed. Here the best seed bacterization terms after treatment with hexachloran, granosan, and preparate TMTD have been established.

On the recommendation of the Institute of Microbiology, a Bacterial Fertilizers Laboratory was established at the Tiraine Experimental Station and became operative in 1955. The production capacity of this laboratory is 15,000 to 20,000 hectare portions of the bacterial fertilizers to be used at seeding time. The Institute of Microbiology systematically supplies this laboratory with starter cultures needed for the production of bacterial fertilizers.

During recent years studies on the originators of vegetable bacterioses have been started. The objective of these studies is to find biological methods for the fight against these plant diseases.

Great work during Soviet administration has been done in the preparation of specialists of the highest caliber. During the period from 1946 to 1960, 25 dissertations of science candidates were prepared and successfully defended in the various fields of microbiology. Some of these specialists work at the Institute of Microbiology, but many others work in other scientific-research institutions and universities where research work in microbiology is successfully carried on.

During Soviet administration 12 volumes of writings on different microbiological and virological problems have been prepared and published and also many popular-science books and brochures. Research work of a microbiological character has been published in many other publications and also in the Journal of the Academy of Sciences of the Latvian SSR.

This year, the twentieth for Soviet Latvia, we can well see that the flourishing of science, as well as that of all other branches of our life, has been secured by nothing else but by Soviet administration.

PATHWAYS AND RESULTS OF DEVELOPMENT OF  
MEDICAL SCIENCE IN THE LATVIAN S.S.R.

1940 - 1960

by A. Smidt

Pages 153-161

The restoration of Soviet power by the Latvian people in 1940 opened up new possibilities for Latvia in the development of science. While in bourgeois Latvia some research was done in medicine in individual departments and clinics, from the moment of coming into being of the Latvian S.S.R., the position changed radically. In the Republic we have scientific centers such as, for example, the medical institutes of the Academy of Sciences of the Latvian S.S.R., the Riga Medical Institute and the Traumatology and Orthopaedic Research Institute. In these institutes, the scientific staff engaged in creative work numbers overall thirty-two doctors of science and a hundred and sixty-four candidates.

While in bourgeois Latvia there was a shortage of scientific medical cadres, in Soviet Latvia we have a host of outstanding scientific medical personalities working with their numerous pupils in solving important problems of their discipline.

As from 1940, in the higher places of learning and research institutes of Soviet Latvia, the method of training scientific cadres through the aspirant system tried and proven over many years in the other Soviet Republics has been in operation. Thanks to this method, medical science in the Latvian S.S.R. now has at its disposal highly

qualified specialists, not only fully trained for independent research but capable of guiding the development of the expanding younger generation of medical scientists.

The scientific medical workers of Soviet Latvia subscribe to the principles of Leninist philosophical science. In our country, as in all the Soviet Republics, the gap between theory and practice in medicine, existing in bourgeois Latvia, has been closed. The problems of practical medicine are at each stage intimately intertwined with the problems of theory.

Under Soviet power in Latvia, a system of planned research activity has been introduced, which without weakening the creative initiative of individual workers makes possible the co-ordination of scientific work, directing it towards solution of the most important outstanding problems.

Scientific work in the field of medicine which in bourgeois Latvia was the private concern of the individual scientist, has been converted into a public concern financed by the state and under its control. While formerly in Latvia researchers worked in isolation, with the introduction of systematic planning in the sphere of medical science the possibility was created of applying the principles of concerted research by whole groups of scientists working in the same branches.

Thanks to the concern of the Communist Party and Soviet Government for the welfare of the Soviet people, in socialist society medical science occupies a prominent place in the field of prophylaxis and protection of the health of the workers. Soviet medical science has an exceptionally fine record of service in all spheres of public health. This applies also to public health in the national republics where before the great October Socialist Revolution the people were almost completely without systematic medical assistance.

Turning to consideration of the actual achievements in medical research in the Latvian S.S.R., it should be noted that they all stem from the All-Union State Plan endorsed by the Academy of Medical Sciences of the U.S.S.R. In the development of medical science in the Soviet Union, the seven-year plan envisages scientific research on fifty problems among which a large place is given over to the study of general problems of biology, the basis of clinical medicine.

In the branch of clinical medicine, the seven-year plan directs the efforts of medical scientists to the solution of the most pressing problems such as cancer,

atherosclerosis, myocardial infarct, sclerosis of the coronary vessels, hypertension, dysentery, whooping-cough, diphtheria, poliomyelitis, dental caries, infective hepatitis (Botkin's disease), etc.

An important place in the plan for scientists is occupied by problems of public health and hygiene.

The 1959-1965 plan for the study of fifty problems throughout the Soviet Union assigns to the Latvian S.S.R. responsibility for fifteen. The bodies with the main responsibility for implementing the plan are the Riga Medical Institute (RMI) and the medical institutes of the Academy of Sciences of the Latvian S.S.R. (Institute of Experimental Medicine (IEM), Institute of Microbiology (IM), Institute of Organic Synthesis (IOS) and also the Institute of Traumatology and Orthopaedics of the Ministry of Health of the Latvian S.S.R.). Medical practitioners are also to be drawn into the work on a number of problems.

Among the problems of medicine now being tackled by Latvian scientists is that figuring in the plan as "General Patterns of Morphogenesis in the Light of the Relation between Tissue Structure and Function". Responsibility for this problem rests with Academician P. J. Gerke of the Academy of Sciences of the Latvian S.S.R. with the relevant investigations being conducted in the main in the department of normal anatomy of the RMI (Head: Prof. V. A. Kalberg) and in the morphophysiology department of the Institute of Experimental Medicine of the Latvian S.S.R. (Head: Acad. P. J. Gerke). The problem involves a study of such questions as the interrelation of blood vessels and nerves and also the morphology of both, prominence being given to growth and developmental patterns of the body. Attempts are being made in this direction to establish in the embryo the chronological change in animal forms in phylogeny and the significance of correlated factors. Attention is concentrated on problems connected with histochemical and biophysical investigations of the structural elements of the organism. Problems of nervous regulation of the processes of cell division receive special study.

In the Soviet Union, a systematic fight is waged against occupational diseases, in the study of which it leads the world. Sanitary-hygienic measures applied in industrial undertakings and among agricultural workers have reduced to a minimum the number of patients with diseases caused by occupational hazards.

There were no specialists in occupational diseases in the old Latvia. With the establishment of Soviet power in Latvia, a department of hygiene was set up in the



Academician A. Shmidt of the Academy of Sciences  
of the Latvian S. S. R. with colleagues

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medical faculty of the State University. The members of this department working in close contact with specialists in Moscow, Leningrad and other industrial centers of the Union are conducting very important research in the field of occupational hygiene and thereby providing assistance to workers in industry and agriculture.

Public health-hygiene research is concentrated on the problem "Hygiene in Populated Areas", a campaign led by Assistant Professor M.D. Garbarenko. Research here is being conducted by members of the department of hygiene of the RMI and medical men in the public health-epidemiological stations of the Republic.

Among the prophylactic measures for the prevention of the health of workers in the U.S.S.R. of great importance is correct nutrition. In a country engaged in the construction of a Communist society, there is a steady "all for the material well-being of the population together" work, increased food supplies.

The research work undertaken in Latvia in relation to rational diet is focused on the problem "Physiological Bases and Hygiene of Nutrition for the Healthy and the Individual" and is being undertaken by the scientific staff of the Institute of Experimental Medicine in Latvia and the RMI with responsibility for the problem given over to Academician A.A. Schmidt of the Latvian S.S.R. Academy of Sciences and Doctor of Medical Sciences, K.A. Skulme.

Valuable work has been done in the Soviet Union in the production of new medicinal substances. Definite achievements have also been registered here by medical science in Soviet Latvia. In our Republic, as a result of successful collaboration between synthetic chemists, pharmacologists and clinicians, valuable research has been developed into new chemotherapy.

Research along these lines is directed at the problem "Mechanism of Action of Medicinal Substances and Study of New Pharmacological Agents and Chemotherapeutics" and is carried out by the staff of the ICS and IEM of the Academy of Sciences of the Latvian S.S.R. and also by the RMI, under the general direction of S.A. Giller, Academician of the Academy of Sciences of the Latvian S.S.R., Corresponding Member of the U.S.S.R. Academy of Medical Sciences, Prof. M.P. Belenki and Honoured Doctor of the Latvian S.S.R., S.P. Zayevci.

In the production of new chemotherapeutics and their biological-clinical trials, chemists and pharmacologists together with the medical profession of Latvia have worked out original methods for obtaining para-amino-salicylic

acid, tubazide, furacillin, etc. In recent years valuable work has been done on the relationship between the chemical structure, physico-chemical properties and pharmacological action of a whole number of new organic compounds. Research is also being conducted into the mechanism of the anti-microbial and pharmacological action of some derivatives of the nitrofuran, furfuran and indandione series. The tuberculo-static action of compounds with hydrazine groupings combined with other functional groups has been studied. Highly noteworthy are the investigations of synthetic chemists aimed at the synthesis of compounds with predictable anti-carcinogenic action.

The experimental work now completed has led to the introduction into medical practice of valuable chemotherapeutics such as furazidine (treatment of urological and surgical infections), tetramine (ganglion-blocking preparation for treatment of high blood pressure) omephin (blood anticoagulant with high efficacy), methamphidone (non-barbiturate hypnotic), ethamphon (anti-convulsant for the treatment of epilepsy) and so forth.

Highly relevant to a number of microbiological investigations is the problem "Variation in Microorganisms and Bacteriophages" studied under the direction of Academician of the Academy of Sciences of the Latvian S.S.R., Hero of Socialist Labour, A.M. Kirhensteins. This covers work on the variation in influenza and poliomyelitis viruses circulating in the Latvian S.S.R. During systematic study of poliomyelitis virus in the last two to three years, virologists of various countries have isolated more than forty new viruses causing diseases akin to poliomyelitis. These viruses termed cytopathogenic have also been isolated in the Latvian S.S.R. Recently, research into these viruses has been aimed at pinpointing the link between them and diseases of as yet uncertain aetiology.

Connected with this problem is that of "Virus Diseases", work on which is directed by Academician of the Academy of Sciences of the Latvian S.S.R., A.M. Kirhensteins and Candidate of Medical Sciences Kukainis. Research here is aimed at extending our knowledge on the epidemiology and prophylaxis of poliomyelitis and influenza. The significance of the reactivity of the microorganism in the formation of immunity to virus diseases, in particular to poliomyelitis and influenza is being studied. Research is underway on the efficacy of poliomyelitis vaccination aimed at establishing the intensity and duration of the immunity formed as a result of vaccination.

As for the epidemiology of influenza, research is



Corresponding Member of the U. S. S. R. Academy of Sciences M. Belenkiy with colleagues of his department.

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proceeding into changes in collective immunity and elucidation of the factors responsible. Solutions of these problems will allow proposals to be put forward on influenza prophylaxis.

In the systematic plan for the study of infectious diseases in the Latvian S.S.R., reference must be made to the problem "Enteric Infections, chiefly Dysentery", a problem being tackled under the direction of Doctor of Medical Sciences, M.M. Budzhe mainly in the department of infectious diseases of the RMI. In this connexion, work is also being done on such key problems as the cause of conversion of acute into protracted, chronic dysentery. Systems and methods of therapeutic-prophylactic measures for prevention of chronic dysentery are being worked out.

The main trend of research on this problem is clinical study of antibiotics and new chemotherapeutics of the class of nitro-furfurans synthesized in the Institute of Organic Synthesis of the Latvian S.S.R. Academy of Sciences and used in the treatment of acute intestinal infections. The clinical effectiveness of the compounds tested is studied by means of immunological, bacteriological, instrumental, X-ray and other methods aimed at making evaluation of the treatment fully objective.

Among chronic infections of the human organism, a prominent place is occupied by tuberculosis diseases. The heading "Tuberculosis" covers these diseases. The problem is being tackled under the general direction of Doctor of Medical Sciences N.S. Stolygov at the tuberculosis unit of the IEM and in the RMI and the Institute of Microbiology of the Latvian Academy of Sciences. Medical practitioners in the tuberculosis hospitals and out-patient departments of Riga are active in this work. Research is chiefly aimed at improving methods of treatment and prophylaxis of tuberculosis. Problems of the epidemiology, microbiology and immunology of this disease are studied with special attention paid to study of factors responsible for the development of clinical disease in persons infected with tuberculosis. Considerable attention is devoted to extra-pulmonary tuberculosis, in particular, bone-joint tuberculosis and infection of the eyes. Chemoprophylaxis of tuberculosis in children is studied.

A major and serious problem of modern medicine is that of malignant growths, which as "Malignant Neoplasms" occupies a leading place in the medical research of the Republic. The initiator in Latvia of the comprehensive study of malignant growths must be considered to be Academician of the Latvian Academy of Sciences,

Corresponding Member of the U.S.S.R. Academy of Medical Sciences, the late P.I. Stradyn, who carried out a series of brilliant investigations in this field. Under his leadership the school of Latvian oncologists grew up. One of the representatives of this school Candidate of Medical Sciences V.M. Bramberg is now directing fundamental research into problems of oncology.

The prophylaxis and treatment of rheumatic diseases are assuming great importance for the Soviet health service. The fight against rheumatism was particularly urgent in the post-war years, when the number of such patients increased appreciably. The solution of the problem of rheumatism is also of interest to the Latvian S.S.R. in that our Republic has at its disposal health resorts equipped to treat this affliction.

Research into rheumatism is being undertaken under the heading "Rheumatism and Diseases of the Joints" with Honoured Man of Science of the Latvian S.S.R., Prof. K.K. Rudzit responsible. A number of departments of the Riga Medical Institute are working on this - the departments of children's diseases, otorhinolaryngology, dentistry and therapy. School doctors of the Republic also pursue this work and much is done to prevent rheumatism in children of school age.

Soviet investigators in this field of theoretical and practical medicine have achieved much in study of the serious disturbance - high blood pressure. The timely detection of the causes of development of hypertension will greatly help medical practitioners to put into practice individual and collective prophylactic measures.

Problems of high blood pressure and associated cardio-vascular diseases occupy a prominent place in the research work of the Latvian S.S.R. since myocardial infarct, hypertension and sclerosis of the coronary vessels are very widespread amongst the people of the Republic. Problems relating to these diseases are grouped under "Hypertonic Disease, Atherosclerosis and Coronary Deficiency". Under the direction of Honoured Man of Science of the Latvian S.S.R., K.K. Rudzit, the research is, in the main, being undertaken at the RMI and the IEM of the Latvian Academy of Sciences.

The problem is studied from the standpoint of the significance of the physiological regulation of vascular tonus in normal and pathological conditions. Attention is chiefly focused on problems such as the reflex influences of various reflexogenic zones of the gastro-intestinal tract on vascular tonus, the importance of patterns of

vascular reactions in hypertension and endarteritis obliterans, the link between diseases of the cardio-vascular system and the state of the endocrinial and haemopoietic systems and the role of prophylaxis in cardio-vascular disorders in relation to the importance of focal infection in their pathogenesis. Bearing in mind the advances made in heart surgery and surgery of the large vessels research is being directed to giving more precise indications for surgical treatment of cardio-vascular diseases.

Exceptionally important within the framework of the Society health service is the problem "Protection of the Health of the Female, Mother and Newborn Child". In the Latvian S.S.R. it is receiving attention from the staff of the department of obstetrics and gynaecology of the RMI together with many medical practitioners under the guidance of Honoured Man of Science of the Latvian S.S.R., Professor R.I. Shub. This was one of the least developed branches of medical science in bourgeois Latvia. Our Republic now has not only good teaching cadres but qualified obstetrician-gynaecologist specialists actively participating in solution of theoretical and practical scientific problems.

Research is being done in the field of prophylaxis and treatment of intra-uterine asphyxia and cerebral haemorrhages of the foetus and newborn. Work is carried out on the prophylaxis of birth injuries and prevention of complications after miscarriage. The immediate and late results of gynaecological interventions are being studied and the role of vaginal inspection in obstetrics has been clarified.

Workers in the department have devoted much attention to the clinical value of chemotherapeutics of the nitrofuran series in obstetric and clinical practice. In this connexion, investigations have been carried out in close contact with the staff of the Institute of Organic Synthesis of the Latvian Academy of Sciences.

Latvian obstetricians and gynaecologists in collaboration with the All-Union Vitamin Research Institute are studying the role of the most important vitamins in the physiology and pathology of the female body, foetus and newborn. The results of this research are of great practical importance in the prophylaxis and therapy of certain forms of obstetric pathology. They should also be utilized for the prevention of diseases and developmental disturbances in early childhood.

The Latvian S.S.R. has a large network of health resort-sanatoria institutions available to the entire Soviet Union. This brings together not only many workers in the health resort network but also medical scientists who are seeking to define the specific therapeutic factors of the health resorts of Latvia.

In bourgeois society, the spas of Latvia were exploited in the main by private individuals for profit. Now they serve as places of rest and recuperation for the working population as a whole. In the sanatoria of the Latvian S.S.R. specialists in health resort matters in collaboration with their counterparts in other Republics are engaged in intensive scientific activity aimed at disclosing how the therapeutic effect of the procedures employed is exerted and at discovering as yet unstudied factors. In the systematic plan of the Republic, this research centers on the problem "Mechanism of Action of Health Resort, Physical Factors and Therapeutic Applications". The persons responsible are Professor P.D. Perli and Candidate of Medical Sciences V.G. Portnov aided by staff of the IIN of the Latvian Academy of Sciences and of the RMI as well as the physicians working on the spot in the sanatoria.

The results of research show improvement in the health of hypertensive patients availing themselves of treatment at the Riga beach health resort. One of the most important factors in hypertension therapy there is the negative aerationization of the air.

The desensitizing effect of the balneological factors at the Kemer Spa has been demonstrated. Methods of prolonging and enhancing the desensitizing effect of the muds and hydrogen sulfide baths are now being studied.

Biochemical and physiological methods are being worked out to obtain an objective assessment of the effectiveness of Kemer Spa therapy in rheumatism, residual phenomena of poliomyelitis, endarteritis obliterans, lumbosacral radiculitis and hypertension.

The mechanism of the therapeutic action of the muds and sapropel found in the Latvian S.S.R. has still received comparatively little study. The effect of the sapropel muds of Lake Babit on certain haemodynamic factors has already been studied. In addition, research has been conducted into the effect of the hydrogen sulfide baths and muds of the Kemer Spa in the treatment of patients with dermatoses. Alongside the role of the nervous system in changes in the reactivity of the skin resulting from these health resort factors, the biochemical changes in the body of patients with skin disease also figures in this work.

The results of the relevant research provide valuable information for compilation of instructions on referral of patients for treatment to the health resorts of Latvia.

Medical scientists of the Latvian S.S.R., from the time of setting up of Soviet power in the Republic, have worked on highly important practical problems which can be classified under the heading "Trauma. Industrial, Agricultural and General Traumatism and Gunshot Wounds". In investigating this subject contributions have been made by the staff of the Traumatology and Orthopaedics Research Institute and the RMI. This problem is the responsibility of Honoured Man of Science of the Latvian S.S.R., Professor A.P. Biezinen. The following special aspects have been dealt with:

(1) prophylaxis of traumatism and orthopaedic disorders (agricultural injuries and traumatism in the shipbuilding, ship repair and slating sectors of industry, injuries in childhood);

(2) treatment of lesions (osteosynthesis of open fractures, long bone fractures, treatment of third degree burns, study of restoration of the structure of elements of the hip joint in congenital dislocation of the hip, poliomyelitis and traumatic lesions of the lower limbs);

(3) prophylaxis and treatment of orthopaedic disorders and deformations (study of methods of treatment of the sequelae of poliomyelitis, improved surgical methods for scoliosis in children and juveniles, research into the early detection in the maternity homes of Riga of congenital deformations); and

(4) scientific bases of organization of traumato-logical and orthopaedic services for the population.

In the Latvian S.S.R. the staffs of the department of dentistry of the RMI and dental practitioners of the Riga Children's Dental Polyclinic have made relatively wide progress in the analysis of the problem "Prophylaxis and Treatment of Dental Caries and Parodonitis" with Professor D.A. Kalvelis responsible.

The investigations are being carried out along two main lines:

(1) morphology and physiology of the tissues of the teeth and periodontium (orthopaedic pretreatment of maxillo-dental abnormalities, study of tissue changes brought about by non-removable dental prostheses); and

(2) clinical aspects and methods of treatment of dental caries and its complications (single-session treatment of pulpitis, maintenance of viability of the

partially-inflamed pulpa and treatment of pericementitis, role of complications of dental caries in the pathogenesis of rheumatism and diseases of the cardio-vascular system).

The branches of medical science considered by us naturally do not reflect all the problems which have engaged the attention of medical scientists and practitioners during the twenty years' existence of Soviet Latvia.

Our Republic now has scientific cadres trained to undertake scientific research along the main lines of medical science, while at the same time themselves are prepared to train highly qualified physicians in all special subjects. During the period since the liberation of Latvia from the German-Fascist plunderers, in the scientific institutes of the Academy of Sciences of the Latvian S.S.R. and the Riga Medical Institute over 180 dissertations have been defended for the award of scientific degrees: Doctor and Candidate of Medical Sciences.

The Communist Party and the Soviet Government are making efforts to improve the health service of their people. We are an expression of Leninist care for the welfare of the people in the decisions of the Twenty-first Congress of the Communist Party of the Soviet Union and in the joint resolution of the Central Committee of the Communist Party of the Soviet Union and the Soviet Ministers of the USSR. These important documents must also act as a guide for medical scientists in the Latvian S.S.R.

ON EXPERIENCE IN INTRODUCING RADIOACTIVE  
ISOTOPES AND NUCLEAR RADIATIONS INTO  
ESTABLISHMENTS OF THE NATIONAL ECONOMY  
OF THE LATVIAN S.S.R.

by G. Gayle

Pages 163-171

The Central Committee of the party has set us the task of creating, in the coming years, the material basis for the realization of the golden dream of humanity - the building of a communist society.

The whole Soviet nation - workers, kolkhozniks, engineers, students - are working with enthusiasm to reach this grandiose goal.

The XXI party congress resolved to overtake and surpass the most advanced capitalist country - the USA - in all areas of the economy in a very short time.

The successful results of the first year of the seven-year plan have shown not only that these tasks are within the capabilities of the nation but also that the targets may well be reached ahead of time.

The XXI congress and the July plenum of the Central Committee of the CPSU underlined the need for fulfilling the plan for accelerated technical progress in the interests of the early attainment of the goals of the seven-year plan.

Therefore we technical workers have a special responsibility and the government and the party have urged us to create a series of new laboratories and design offices.

In our republic, as in the rest of the nation, there is a great deal of socialist competition aiming at completing the seven-year plan in five years. In July of this year the workers of Soviet Latvia celebrate the 20th anniversary of their entry into the multinational family of the Soviet state. During this short period the Latvians like the rest of

the Soviet people have endured a destructive war.

Twenty years ago Latvia was an agrarian state. At the end of the war our country's feeble industry was completely paralvzed. Thanks to our sister republics we have not only recovered but flourish more than ever before.

Under the direction of the Communist Party Soviet Latvia has been converted from an agrarian to an industrial-collective farm economy. Its main industries are now electrical machinery, agricultural machinery, instrument-making, transportation machinery, radio engineering, etc. The organization of the Latvian administrative-economic region stimulated industry still further by liquidating a number of smaller enterprises and forming larger, specialized groups.

The chief problem facing industry is the mechanization and automation of production processes, the transition from the automation of individual operations to the automation of sections, shops and whole factories.

The National Economy Council of the republic has therefore organized a whole series of new technical services - The Central Design and Technological Bureau of Sovnarkhoz and branch design offices: groups, sections and departments for the automation and mechanization of production processes have been set up in various factories.

In 1959 alone Sovnarkhoz enterprises achieved an economy of more than 160 million roubles from the introduction of new techniques and advanced procedures.

The success of the program depends to a large extent on the development of modern methods of active production control. High on the list are methods and apparatus based on the use of radioactive isotopes and nuclear radiation.

To this end the various Sovnarkhoz organizations and establishments are cooperating closely with the Academy of Sciences of the republic.

Apparatus based on radioactive isotopes has been installed in a number of factories since 1955. Experience has clearly shown that radioactive apparatus is very reliable, simple to handle, and, above all, universal in application, so that it can be used for controlling processes not susceptible to control by other means.

In 1958 the National Economy Council organized a commission to explore the technical possibilities and economic advantages of using radioactive isotopes and nuclear radiation in all branches of industry.

Besides Sovnarkhoz workers, branch managements, the central auditing department and factory engineers, the work of the commission attracted workers of the Academy of Sciences of the republic.

The commission investigated the possibilities of intro-

ducing radioactive apparatus for automation purposes and reported on the economic aspects of the problem.

It was found that the economic advantages consisted in increasing the productivity of plant, reducing labor requirements, economizing in raw materials, improving the quality of production, eliminating or considerably reducing waste, and consequently, in cutting costs and raising profits.

The commission worked out new schemes for improving labor conditions while observing strict safety requirements. The cost of introducing radioactive instruments would be covered by the resulting economies in the course of a few years.

The commission also investigated the possibility of using alternative physical methods. The adoption of radioactive methods was made conditional on other methods being unavailable or more complex, less reliable and less economical. The chief attention of the commission was directed to exploring the possibility of the efficient application of typical installations for the automatic control and regulation of analogous processes in different branches of industry.

In solving the problems of complex mechanization, trails were blazed for using radioactive apparatus together with other means of controlling technological processes.

An inspection of Sovnarkhoz establishments revealed that the use of radioactive automation methods had made possible economies of more than 20 million roubles a year in the inspected and allied enterprises.

The commission's report was debated by the Technical and Economic Council of Sovnarkhoz and attracted the attention of scientists, the chief specialists of the Scientific and Technical Committee and Gosplan of the republic; their interest was shared by the Board for the Utilization of Atomic Energy of the Council of Ministers of the USSR and the Scientific and Technical Committees of the Baltic republics.

The report to the Technical and Economic Council served as a basis for a plan for the development of radioactive production control apparatus and its introduction into Latvian industry in 1959-60.

In the branch design offices and several leading factories groups and laboratories were organized for dealing with radioactive isotopes.

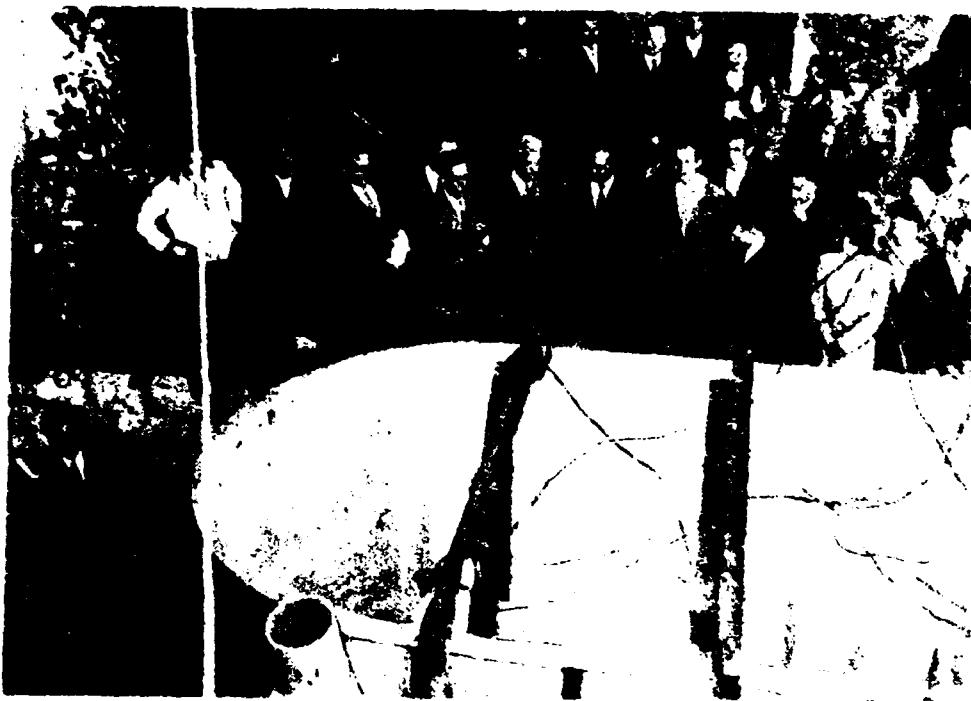
In 1959 a radioactive automation design office was organized in the "Avtoelektropribor" works to assist in carrying out the program.

In collaboration with the Institute of Physics of the Latvian Academy of Sciences and the Institute of Automatics and Telemechanics of the AS USSR, and advised by Glavavtom, this design office has developed and prepared for production a complex of radioactive apparatus, based on recording a modul-

ated flux of radioactivity.

During its short existence the design office has developed a number of instruments based on this principle: a radioactive flowmeter for viscous liquids, a contact-free radioactive tachometer for electric trains, etc.

To improve coordination in the application of radioactive methods to various branches of the economy, the Scientific and Technical Committee of the Latvian S.S.R. has organized a permanent commission for the introduction of radioactive isotopes and nuclear radiation into the industry of the republic. The commission has worked out the main lines along which progress should be made.



Laying the foundations of the atomic reactor of the Academy of Sciences of the Latvian S.S.R.

The commission is exploring new possibilities of employing radioactive techniques of regulation and control not only in industry but also in other branches of the national economy: on the railroads, in the mechanization of agriculture, etc.

The commission has given practical assistance to Sovnar-khoz by organizing "creative brigades" designed to attract scientists to developing new automation systems, by evaluating new schemes submitted by other offices and agencies and by supervising the practical introduction of new techniques.

It should be noted that the establishments of the Latvian Sovnarkhoz have comparatively little experience in using radioactive isotopes. They began to employ them only in 1955, considerably later than other establishments of the Soviet Union. In our republic isotopes are mainly being used for control apparatus designed by the Institute of Physics of the Academy of Sciences of the Latvian S.S.R.

The first of these instruments were made by the Riga "VEF" electrical engineering works. At present, Latvian Sovnarkhoz establishments are getting their radioactive instruments, complete with standard radioactive sources, mainly from the Estonian Sovnarkhoz. These instruments have been designed by the Institute of Physics of the Academy of Sciences of the Latvian S.S.R. in collaboration with the "KIP" works in Tallinn.

The Riga "Avtoelektropribor" works began to produce radioactive apparatus during the first half of this year.

Relay-type radioactive instruments are the ones most used in our factories at present; non-contact thickness and density gauges are beginning to be used in the manufacture of sheet materials.

Here are a few examples drawn from experience in our factories.

The Liepaya cork-linoleum factory has introduced automation in preparing the mixtures of loose products that form the main components from which linoleum and cork articles are made. Radioactive pickups, installed on the dial weighing machines and hoppers for controlling the weight of the raw materials, in conjunction with a system of pneumatic conveyers, have made it possible to automate the supply of components to different sections of the production network inside and between shops.

This year it is planned to complete the complex automation of all the pneumatic conveyer communications system and materials handling system, an annual economy of not less than 500 thousand roubles.

The Riga oil combine has introduced an automated system for controlling a single-unit vacuum-evaporator for preparing glycerin from glycerin water. The control of the main parameters - density and level of liquids in various parts of the apparatus - is realized with radioactive instruments of the relay type.

Last year the combine saved 64 thousand roubles from this improvement alone.

In the first quarter of this year the leather-shoe combine "Blazma" completed the automation of a three-unit vacuum evaporator for obtaining tannin extract. The resulting economy will be 200 thousand roubles a year.

A typical scheme has been worked out for automating

vacuum evaporator installations. Its application to a three-battery installation at the "Sloka" cellulose-paper combine will mean substantial savings even in the first year.

We ascribe great importance to the automatic contact-free control of the thickness and density of sheet materials.

The chief targets for these applications of radioactive apparatus are the glass, paper and linoleum industries.

Only the absence of reliable means of automatically controlling thickness can explain the present generous tolerances in paper production. Paper is supplied by weight, in rolls. Therefore in spite of the economic disadvantages paper factories often work to the upper limit. They thus get a large weight of paper for a small surface area. The use of radioactive thickness gauges makes it possible to change the standards and by working to closer tolerances get more paper out of the same amount of raw material.

At present instruments for controlling thickness and density (type MRIT-1), designed by the Institute of Physics of the AS Latv. S.S.R. in collaboration with the "NII" works in Tallinn, have been installed in the "Sarkandaugava" glass factory and the "Sloka" paper combine. According to preliminary calculations, the use of these instruments in establishments of the Latvian Sovnarkhoz, simply in controlling technological processes, will save hundreds of thousands of rubles by reducing consumption of raw materials - cellulose, glass and linoleum bodies.

The second stage of the automation process relating to that fundamental control parameter - thickness - permits even greater economies.

Radioactive locking devices have been put to varied use in a number of works.

In the "Sarkandaugava" glass works VVS machines have been adapted for the automatic control of the operation of cutting drawn glass. Using a non-contact radioactive method instead of an electromechanical contact on two machines save a saving of 100 thousand rubles in 1959 due to more accurate cutting and reduced incidence of spalling.

The same automatic locking principle has been used to automate the ejection of sheet from conveyers in the "Sarkandaugava" metallurgical works.

In the Riga "VTS" electromechanical works radioactive pickups have been extensively used in electrotechnical control and measuring apparatus. For several years radioactive temperature regulators have been used for the electric furnaces and oil baths in the instrument shop and other sections of the works.

Using a radioactive a.c. voltage regulator in the radio production shop made it possible to stabilize the sinusoidal

mains supply in apparatus intended for checking radio receivers. The regulating accuracy of  $\pm 1\%$  made it possible to increase the quality of the radio sets produced.

In the same shop a semiautomatic installation was mounted on the conveyers for testing the power and output transformers of radio receivers with the object of sorting transformers according to the symmetry of the primary and plate windings and the open-circuit current. In these installations the principal element was a radioactive maximum current relay. The installation could handle 350-500 transformers per shift. This meant that the requirements of the factory as a whole could be met with two machines, which have already been working for several years. The "VEF" works have prepared several such installations for Union factories.

A device for sorting and checking magnets with respect to the inductance excited in the air gap of a loudspeaker was also developed and applied in the same works.

The indicator was a radioactive relay of high sensitivity with an operating power of the order of 0.01 microwatts. The device handled about 5,000 magnets per shift.

Indicating voltmeters with radioactive transducers have been set up to check and indicate the voltage of storage batteries produced by "VEF" for interurban telephone and telegraph exchanges.

The equipment of automatic telephone exchanges has been supplemented with automatic devices for testing the racks of remote subscribers. This device employs a kilohmmeter with a radioactive pickup of the relay type. It is used for automatically testing the direct circuits of the racks measuring the capacitance of the capacitors and the resistance of the cord jacks. The testing process is accelerated 8-10 times and the risk of defects diminished.

Radioactive pickups are now been widely used in apparatus for measuring pressures. Thus, for example, the "Sarkanays metalurgs" works has introduced automatic protection for the compressor equipment in the oxygen section, completely eliminating the risk of damage as a result of excessive pressure, developing out of the absence or slackness of the operating personnel.

Pressure regulators of a similar type have been installed on the receivers of pressure casting machines in the "Avto-elektropribor" works, on compressor installations in the "Dzintars" cosmetics factory and in a number of other enterprises.

The general economies achieved in 1959 by introducing radioactive control systems into the establishments of the Latvian Sovnarkhoz have been comparatively small, amounting to about 600 thousand roubles. But it should be mentioned that

last year the AC Latv. S.A.P. assisted factory personnel in designing and testing under production conditions a number of automatic units, which this year will be introduced into many factories as prototypes and test models.

Under the plan for introducing new techniques, an automatic reworking method will be introduced into 1000000 workers in 1960. The cost of the said work is 1.5 million rubles.

The main difficulty encountered in introducing automatic reworking techniques is the absence of qualified engineers in the design offices of most factories. Most of these have no control teams and therefore do not have the basic calculation techniques. It is necessary to train a number of engineers if control is to be carried out automatically. It is also necessary to train a number of reworking workers of 1000000 men, who will be qualified for this kind of work.

In collaboration with a number of scientific and technical facilities of the Ministry of Ministers of the USSR, the computer and radio engineering schools, the technical colleges and factory workers will be involved in this production.

About 400 engineering and technical workers are engaged in systematic study. About 200 men have started a 100-hour program of compilation of the operational and production instructions, they have to work out and record in detail the operations for which they are responsible or responsible as a whole project. This we hope to achieve by means of automation in improving the efficiency of production, increased by automation and training qualified engineers to carry out the work.

In a short program of 300 engineers and technicians, a following course designed to familiarize them with the main techniques of reworking and control. The chairman of the Central Committee of the All-Union S.A.P. has recently appointed 1000000 reworking instructors.

The technical board of Riga-robot has appointed a special engineer to coordinate the work of instruction and training for the work of supervising the design and construction of projects.

It should be noted that the short experience of the country in automatic reworking techniques definitely confirms the tremendous technical possibilities of automation. The advantages of this new and powerful means of technological work. However, it has also revealed a number of shortcomings connected with the development and application of such methods and the results.

The introduction of isotope techniques has been planned

retarded by a factor already referred to, the shortage of trained personnel.

The Ministry of Higher and Secondary Education is preparing an insufficient number of specialists in radio electronics and modern automation techniques. The state of affairs is even worse in connection with the training of skilled workers at intermediate levels.

Another obstacle is the lack of an adequate industrial base to supply the control apparatus and auxiliary mechanisms to the factory design offices and Sovnarkhoz establishments. In the "Avtoelektropribor" works we have plans for setting up such a base with the corresponding plant.

Our industry is experiencing an acute shortage of auxiliary mechanisms - electromagnetic valves, servomechanisms, electric drives, etc. It is often difficult to get reliable information on the availability of auxiliary mechanisms; there is no serious standardization of these important automation elements. As a result many factories rely on home-made jobs. This often means that apparatus is operated without a full set of ancillary and spare parts.

We are experiencing a great shortage of gas-discharge counters for recording radiation in control apparatus. Unfortunately, the radioelectronics committee of the Council of Ministers of the USSR has still not solved the problem of producing these items in sufficient quantity.

We should also mention the importance of safety measures in working with radioactive substances. Sovnarkhoz has organized the production of protective devices. Last year 28 new protective devices were introduced. Eleven of these are in production in the factories of the republic and the other 17 in factories in other parts of the Union.

Specimens of apparatus and protective devices designed and produced in our factories are on display in the Republic Hall of Scientific and Technical Propaganda.

From what has been written it is possible to draw the following conclusions.

In the course of this year alone 4.3 million rubles will be saved in the Latvian economic region as a result of the introduction of radioactive means of controlling production.

As experience has shown, the use of radioactive isotopes is a powerful means of technical progress and can be extended to all branches of industry.

To extend the use of radioactive isotopes in industry it will be necessary to train corresponding cadres in the factories and design offices, expand research work and broaden the industrial base in relation to instrument making.

To improve coordination in the design of radioactive automation equipment and ensure that the apparatus produced is

properly standardized, it will be necessary to reinforce and expand the radioactive automation design office of the "Avtoelektropribor" works, reorganizing it into the Central Design and Technical Office for Radioactive Automatics of the National Economy Council of the Latvian S.S.R.

In 1961 it will be necessary to equip the "Avtoelektropribor" works to produce means of automation employing radioactive isotopes.

In 1960-61, in addition to the part-time system of training cadres, it will be necessary to organize training for engineering workers in the Riga Polytechnic Institute granting periods of leave for up to six-months study.

The Academy of Sciences of the Latvian S.S.R. must also extend its laboratory research into radioactive methods of automation at the Institute of Physics in order to accelerate the development of new design principles for radioactive apparatus and new methods of applying it efficiently in different branches of the national economy. Increases in the laboratory staff will be necessary.

Even this year it will be necessary for the State Committee on Radioelectronics to solve the problem of producing a sufficient quantity and variety of gas-discharge counters for radioactive instrumentation.

The lack of these counters threatens the success of the plans of the Latvian Sovnarkhoz, and probably of other sovnarkhozes, for introducing radioactive automation even this year.

As for the design of protective devices and techniques, this year it will be necessary to build up a staff of engineers for manning an experimental shop, design office and laboratory.

The fulfilment of the above tasks will enable both our economic region and others to be supplied in the shortest possible time with modern means of automation.

Scientists, engineers, designers and inventors of the republic will bend all their efforts to achieving the maximum exploitation of radioactive isotopes and nuclear radiation in the automation of production processes in the interests of technical progress and will at the same time be making a modest contribution to the building of communism in our country.

SOVIET LATVIAN SCIENTISTS' PROGRESS IN THE  
FIELD OF MECHANICS

by Ya. Panovko

Pages 173-178

Among the sciences intensively developed in Soviet Latvia, especially in post-war years, mechanics with its many branches occupies a prominent position. This article gives a short description of the principal trends of scientific research in this field and the main results achieved.

The work of Latvian scientists specializing in mechanics is very closely connected with that of scientists in other academic centers of the Soviet Union; the results of this work represent a definite contribution to the general store of scientific knowledge in the field of mechanics. On the other hand, the many research subjects have been directly suggested by the requirements of Latvia's rapidly developing industry; however, in these cases, the value of the results of a number of scientific investigations have gone far beyond narrow practical demands.

There can be no doubt that the development of research in the field of mechanics has been helped by the systematically held scientific seminars in mechanics for Riga as a whole, (in ten years three hundred such seminars took place), at which workers in the scientific and higher educational institutions of Riga give lectures and read reviews of their work. An important part has also been played by the annual conferences on the mechanics of deformable bodies held in Riga from 1953 onwards, and also by the Riga conferences on magnetohydrodynamics

(1958-1960), held with the participation of scientists from Moscow, Leningrad and other academic centers. These conferences, at which a useful exchange of ideas took place, helped to spread scientific knowledge and creative ideas among all the participants. Latvian scientists repeatedly read reports at conferences on mechanics in other Soviet towns; two such reports were read at the First All-Union Congress on Mechanics (Moscow 1960). For combining and co-ordinating the efforts of scientific workers in the field of mechanics some value has been derived from the symposia "Questions of Dynamics and Strength" which have been published systematically by the Latvian S.S.R. Academy of Science Press (so far six such symposia have been published). Scientific work has also been assisted by the organization within the Latvian S.S.R. Academy of Science of the Institute of Engineering Technology (1958) and also by the re-establishment (after a forty-year lapse) of the Riga Polytechnic Institute.

The total number of publications by Latvian Scientists specializing in mechanics amounts to several hundred;<sup>1</sup> there have also been twenty theses dealing with problems of mechanics.

The main trends in research have been the following: General problems of the theory of elasticity and plasticity.

Applied theory of elasticity and designs of membrane structures.

Structural mechanics of rod systems.

Applied theory of elastic vibrations.

Theory of machines and mechanisms and design of machine parts.

Mechanics of materials and rheology.

Aerodynamics, gas dynamics and aeroelasticity.

Magnetohydrodynamics.

Methods of experimentally determining the mechanical properties of materials.

Historical reviews.

This research work has been carried out in the Institutes of the Latvian S.S.R. Academy of Science (The Institute of Engineering Technology, The Institute of Building and Architecture, the Physics Institute), and also in the higher educational establishments of Riga (The Latvian State University, The Riga Polytechnic Institute,

(1) A full bibliography will be published in the next symposium "Questions of Dynamics and Strength", issue No. 7.

The Latvian Academy of Agriculture, The Lenin Komsomol Riga Red Banner Higher Military School of Aviation).

Besides this, workers in the higher educational establishments of Latvia have published a series of text books on mechanics in Lettish.

### General Problems In The Theory Of Elasticity and Plasticity

In a series of researches A. Malmeister has examined the problems of the mechanics of a medium capable of twinning. Plastic deformations of a quasi-isotropic body under complex load have been investigated by A. Malmeister, G. Ukhov and I. Kublin. In this work a definite physical bearing is given to various inelastic effects, instead of the usual purely phenomenological description.

The stresses in pressed joints with small disturbances of the axial symmetry have been studied by F. Nutsenek. E. Lavendel has extended Lame's equations to the special case when the Poisson coefficient of the material  $\mu = 0.5$  (incompressible material). This research is of great practical value in designing machine parts made of modern synthetic materials; Lavendel's results are used in the design office of the Riga Coachbuilding Works.

### Applied Theory Of Elasticity And The Design Of Thin-Slab Structures

I. Dyshler has investigated a convenient method for the combined solution of problems in the applied theory of elasticity. This method, previously used by L. Fepple and by the Soviet scientists A. Umansky, F. Varvak and S. Mar'in, was applied by I. Dyshler to the bending of rods and plates of medium stiffness and also to thin-walled tubes of medium length.

I. Gubanov has solved the problem of the rotation of a round flexible rod in a non-deformable curvilinear tube; it was established that if the rod has an initial curvature (before being placed in the tube) and one end be rotated uniformly, the rotation of the other end will be non-uniform. This work arose in connection with requirements in the production of flexible wire rollers (the Riga works "Avtoelektropribor").

Ya. Panovko has investigated bending and torsion in bars of variable width. V. Lukovnikov has studied the

stability of bars and I beams in plane bending.

The solutions of problems connected with the stability and strength of cylindrical shells are given in a number of papers by O. Len'ko and O. Terebushko.

Researches by N. Kalinin, G. Khaikin, F. Granenko and Ya. Panovko deal with engineers' methods of designing membrane structures. Z. Pale, G. Granenko and A. Altukhov have investigated the stresses in heated revolving discs.

### Mechanics of Systems of Rods

Yu. Tarnopol'sky has investigated the bending of beams on elastic supports in certain circumstances which complicate the solution (curved beam in a generalized elastic medium; bending of a beam on an elastoplastic support; the effect of displacements). This work was done in connection with the design of a plastic base for the commutators of electric motors at the Riga Electro-mechanical Works. The same writer carried out an investigation of the space action of a bicycle frame, considered as a multiply redundant structure (the work was required by the Riga bicycle works "Sarkana Zvaigzne").

The temperature stresses in complicated steam supply lines, which constitute multiply redundant structures, have been investigated by A. Strekis.

Using the method of finite differences, E. Tseplitis has examined the problem of the distribution of stresses in electrorivets connecting metal sheets; breaking stresses were taken into consideration as well as shear stresses.

N.G. Kalinin investigated the combined bending of elastically coupled beams.

### Applied Theory of Elastic Vibrations

A systematic series of investigations has been devoted to the problem of so-called structural damping by the Testing Laboratory of the Institute of Engineering Technology of the Latvian S.S.R. Academy of Science (D. Gol'tsev, N. Kalinin, V. Lebedev, Yu. Lebedev, Ya. Panovko and G. Strakhov). This work has already been applied to the design of new high-power turbines (Kharkov Turbine Works).

Methods of calculating the effect of inelastic resistances on vibration processes have been examined in papers by Ya. Panovko. G. Kunnos has studied the shape and

frequency of free vibrations in bridges of combination construction. V. Viksne investigated the effect of inertia on the vibration of beams on elastic supports. I. Melder has examined some nonlinear problems of vibrations in rods and plates acted on by a chain of forces. The effect of the moment of inertia on transverse vibrations in beams has been analyzed by S. Predtechensky. The effect of support conditions on the vibration of control rods in aircraft has been studied by K. Mirtov.

Non-stationary processes in linear and nonlinear systems have been examined in a series of works by V. Orobov. V. Putyatin has suggested an original design for a pendulum pickup for recording torsional vibrations; he has also investigated this system in detail. A. Iatei and A. Muishniuk have investigated the problems of the operating stability of an automatic ball balancer.

The possibilities of a method of direct linearization suggested by Ya. Panovko in 1952 have been investigated by A. Valdman. Incidentally, this method has also been applied to the analysis of nonlinear automatic control networks (Institute of Automation and Telemechanics of the U.S.S.R. Academy of Science).

G. Strakhov has investigated the dynamic stability of a rod with a polar-oriented load. In a number of papers L. Vasserman has systematically examined a series of problems connected with three-dimensional and plane vibrations in rings and curved members with various types of load behavior during the process of deformation. V. Ushakov has investigated theoretically and experimentally the vibration of pipe lines with a fluid flowing inside. I. Kosinsky has studied the vibrations of triangular and trapezoidal plates.

#### Theory of Machines and Mechanisms and The Design of Machine Parts

Papers by O. Ozol and I. Kataev have dealt with general theorems. V. Neiland has applied the method of geometrical characteristics to the analysis and synthesis of five- and seven-part mechanisms. O. Kepe and K. Iutsevich have suggested a design for spiral shafts for feeding conical parts. O. Ozol's research has dealt with crankshaft and connecting rod devices. The action of cams has been studied by A. Doroshenkov. Planetary gears have been investigated by A. Krol', M. Skripka, P. Pan'kov and I. Kataev, and gear drives by M. Skripka and V. Golovkin; the latter have also studied conical gears. The operation

of hydraulic systems has been investigated by V. Voskoboinikov.

The operating conditions of machine tools and presses has been investigated in papers by V. Zars and A. Grikke and those of agricultural machinery by A. Leppik, K. Berza, O. Ozol, L. Gramolin and I. Kataev.

The method of designing pressed joints has been investigated in a number of works from the Laboratory of Machine Design at the Institute of Engineering Technology of the Latvian S.S.R. Academy of Science, mainly in connection with the requirements of the Riga Coachbuilding Works.

#### Mechanics of Materials and Rheology

A. Skudra have investigated the durability of elastic and viscous bodies and of concrete. The effect of creep in heated steel on the operation of machine parts under load has been studied by K. Mitrov. The effect of vibration on the creep of reinforced concrete structures has been studied by A. Malmeister and K. Shkerbelis. The same authors and A. Skudra have studied the deformation of concrete under a complex load (in particular under torsion followed by tension).

The effect of the rate of loading on the behavior of metals has been studied by S. Ainbinder; G. Teters has investigated this effect experimentally on foam concrete.

C. Ainbinder, D. Gol'tsev and V. Pantaleev have carried out a number of investigations dealing with problems of fatigue. The vibration resistance of turbine blades has been studied by P. Zheltov.

Original processes connected with the binding of similar and different metals when mutually plastically deformed ("cold welding" and dry friction) has been investigated in detail by S. Ainbinder and also by Ainbinder in conjunction with Zh. Upit, E. Klokoval and A. Pranch. These investigations have established theoretically and experimentally that the removal of films on the contact surfaces is the basis of the process; thereafter interatomic forces come freely into action. Thus, the plastic deformation is a means of destroying the films which hinder the binding. The above series of works also include a study of the role of residual stresses which arise with the removal of load from the junction (the future of the joint depends on the character of these stresses, i.e. whether it will last or break down).

V. Latyshko has investigated the possibilities of



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new experimental methods of non-destructively evaluating the strength and other physical properties of concrete and reinforced concrete products.

### Aerodynamics and Aeroelasticity

This branch of mechanics has been dealt with in the researches of P. Vinogradov, G. Bobrov, A. Zhukov and P. Sorokin. Vinogradov has studied the singular phenomenon of wing flutter (in particular, taking the non-linearity of the problem into consideration).

### Magnetohydrodynamics

It is known that owing to the great mathematical difficulties involved there is no analytical solution to many of the problems of hydrodynamics. This applies to a still greater extent to magnetohydrodynamics. In this science, therefore, methods of similarity and dimensionality have great value as means of generalizing the experimental data. Such methods have been intensively worked out in the Physics Institute of the Latvian S.S.R. Academy of Science.

I. Kirko has given a complete system of similarity criteria for magnetohydrodynamic phenomena, with the phenomena of heat transfer and Joule losses taken into account. He has established clearly defined regions where model tests of phenomena are applicable and demonstrated the possibilities of approximate modeling and of modeling with various fluids in nature and in the model. The method of dimensionality has enabled him to show that the increase in the Reynolds number with increases in field intensity is a single-valued function of a dimensionless criterion, common to all substances.

A number of works by M. Tyutin, O. Lielaisis, A. Gailitis, Yu. Birzvalka and A. Veza have dealt with the study of liquid metal flow in the presence of a magnetic field. The effect of a magnetic field on the boundary layer has been studied by O. Lielaisis.

An equation has been derived experimentally for the turbulent movement of a liquid metal in a magnetic field (I. Kirko, Ya. Klyavin, I. Tyutin, L. Ulmanis).

Ya. Lielpeter has developed a theory of such flow in a liquid metal induction pump.

A. Mikleson has carried out investigations into the

mixing of liquid metal by means of a traveling magnetic field and the forming of fountains at its surface.

#### Historical Reviews

Latvian scientists have written historical reviews of various branches of mechanics: membrane structures, the dynamic design of structures (Ya. Panovko); the hydrodynamic theory of lubrication (V. Grishko); dynamic buckling (U. Upmanis).

#### Textbooks and Training Appliances

Textbooks in Lettish have lately been published on the subjects of strength of materials (A. Leppik, Ya. Panovko, A. Streikis) and theoretical mechanics (O. Ozol, E. Vasserman, A. Muizhniek, A. Streikis). This will undoubtedly help in improving the training of students of mechanics in the higher educational establishments of Latvia.

#### Conclusion

Although this is a short review it nevertheless shows that scientific research in the field of mechanics is flourishing in Soviet Latvia. Further growth in the number of scientific specialists is undoubtedly a stepping stone to the future creative progress of Latvian scientists who are ready to exert all their power, ability and knowledge for the prosperity of the great Soviet Union.

SOME RESULTS OF THE INVESTIGATION OF BETA-DIKETONES  
IN THE ACADEMY OF SCIENCES OF THE LATVIAN S.S.R.

by G. Vanag

Pages 183-192

Since it was first established, the Academy of Sciences of the Latvian S.S.R. has worked on the synthesis and study of beta-diketones, particularly indandione-1,3 and its derivatives, firstly in the organic chemistry laboratory of the Institute of Chemistry and in latter years in the general organic synthesis section of the Institute of Organic Synthesis. The aim of these investigations was to clarify a series of theoretical problems, and to discover new analytical reagents and new physiologically active substances. With time the latter became the more predominant.

One of the most interesting derivatives of indandione-1,3, is 2-nitroindandione-1,3. Its theoretical interest is that it can exist in three tautomeric forms: in the form of a nitro diketone, a diketonitronic acid, and a nitroketo-enol. Since one chemical investigation of 2-nitroindandione cannot completely decide the question of its structure, its ultra-violet absorption spectra were photographed (1,2), and its polarographic behavior was studied (3). It was found that nitroindandione itself is produced mainly from the nitronic acid form, but since it represents a strong acid, it is strongly ionized in solvents of high dielectric constant and the absorption agent is the nitroindandione ion. In solvents of low dielectric constant the unionized diketo form predominates. Polarographic data prove that in aqueous solution nitroindandione (and also introscindandione) do not exist in a number of equilibrium forms but only in one - a mesomeric anion, or at

least in every case this predominates to such an extent that the existence of the remaining forms is not revealed in the polarograms. According to the structure of these forms similar inferences can be expected from the infrared region of spectroscopy.

There exists in the spectrum of solid anhydrous nitroindandione frequencies of the symmetrical and anti-symmetrical vibration of a nitro group, also vibrations of an aromatic nucleus and carbonyl groups, just as in indandione. From this it follows that nitroindandione exists in the nitro diketo form. In the spectrum of the dihydrate and the sodium salt of nitroindandione frequencies of the mesomeric anion are revealed, suggesting that the structure is nearer the aci-form. Thus, anhydrous nitroindandione and the dihydrate differ not only in their water of crystallization, but are two compounds with differing structure. The nitro diketo form has a great tendency to change into the ionic form, not only in polar solvents (water, alcohol) but also when the solid form comes into contact with water vapor.

In order to make comparisons, the structure of other cyclic 2-nitro-1,3-diketones, namely 2-nitrodimedon, 2-nitro-5-phenylcyclohexanedione (2-nitrophendione) and several of their derivatives, was studied using the aforesaid methods. It follows from the infrared spectra that 2-nitrodimedon, in the solid form, exists in the nitro-enol form, the intermolecular rather than the intramolecular interaction prevailing. The fundamental difference between 2-nitrodimedon and 2-nitrophendione, and nitroindandione is structural. If the first two, in the solid form, represent nitro-enols, then the latter exists in the nitro diketo form or as the ionized nitronic acid. If the anions of the salts of 2-nitrodimedon and 2-nitrophendione are apparently nearer the structure of the enolic anion, then the anion of 2-nitroindandione almost completely corresponds to the structure of the anion of the aci-nitro form. Potentiometric measurements show that in aqueous solutions 2-nitrodimedon and 2-nitrophendione are acids with dissociation constants of the order of  $10^{-3}$ , that is about as strong as formic acid, whereas 2-nitroindandione-1,3 is a strong acid completely dissociated at all concentrations.

2-nitroindandione is a valuable analytical reagent. Apart from its already well known reactions for the isolation and identification of amines, a series of color reactions is shown with hydrazine, antipyrine, pyrrole, carbazole and others (6-3). 2-bromo-2-nitroindandione-1,3,

also gives a series of color reactions (9). The reaction with formaldehyde is especially specific - the appearance of a green fluorescence on warming formaldehyde with nitroindandione in concentrated sulfuric acid (10). Formaldehyde readily reacts with nitroindandione provided the 3 product is isolated from the reaction conditions. In non-polar solvents the "normal" product, 2-nitro-2-methoxyindandione-1,3, is formed (11), in aqueous solutions, depending on the concentration of nitroindandione, a thick yellow oil or solid white product is obtained; the first is apparently an acylal or an acetal, the second its polymer. Their exact nature has not yet been established. It is characteristic that only the last two products dissolve in concentrated sulfuric acid, with slight warming, to give a green fluorescence.

Nitrobromobindone also gives a series of color reactions analogous to nitroindandione; however their sensitivity is lower. Quite the reverse is the reaction between bindone and hydrazine which is more sensitive than that of nitroindandione (13).

Some analytical interest is exhibited by the oxime of nitroindandione, which gives a series of sparingly soluble salts with amines, particularly primary aliphatic (14,15).

2-nitrosoindandione-1,3, (or 2-oximinoindandione-1,3), in ice cold acetic acid, gives a green fluorescence with meta-nitrophenol and paraaminosalicylic acid, which appears to be a specific reaction for these compounds (15).

2-nitroindandione-1,3 gives a series of interesting dark-colored complex compounds with iodides and iodine (17). During the reaction of iodine on the silver salt of nitroindandione, 2-ido-2-nitroindandione-1,3 is obtained; it cannot be successfully obtained by the straight-forward reaction of iodine on nitroindandione or its salts (18).

2-nitroindandione-1,3 readily undergoes a condensation reaction with benzhydrol (19), xanthydrol (20), fluorenol (21), and other hydrols. A systematic study of the reaction with benzhydrol showed that the condensation product obtained 2-nitro-2-benzhydrylindandione-1,3, when treated with alkali "splits off" phthalic acid and gives benzhydrylnitromethane or beta-beta-diphenylnitroethane. A similar type of fission of 2-nitro-2-phenylindandione-1,3 has already been demonstrated by Keymatsu (22), but he did not draw any practical conclusions from his observations. On the basis of fundamental work on the fission of 2-nitrobenzhydrylindandione-1,3, we were able to put forward this method as a preparatory method of nitromethylation. Further developing this method L.P. Zalukaev pointed out the

possibility of its wide application, and thus methods were developed for the nitration of 2-substituted 1,3-indandiones. With the fission of these latter compounds he succeeded in obtaining a series of nitromethyl derivatives, which are difficult to obtain by other methods. Thus, for example nitration of quinophthalone gives 2-nitro-(aliphatic-nitro-quinolyl)-indandione-1,3, fission of which gives 2-nitro-methyliquinoline (26).

Under the action of acetic anhydride (or other anhydrides) and, similarly, concentrated sulfuric acid, 2-nitroindandione-1,3 isomerizes into N-oxyphthalonimide (24, 25), which can be regarded as a derivative of isoquinoline. In this way the path from nitroindandione to a derivative of isoquinoline is opened. It has been shown that N-oxyphthalonimide readily forms dark-colored compounds with polyiodides and that these compounds are more stable than the complex salts of nitroindandione, and their composition is more constant.

The conversion of nitroindandione to a derivative of isoquinoline was carried out in another way. During the investigation of the Beckmann rearrangement of the 2-nitroindandione, it was established that during the reaction of the Beckmann mixture of phosphorus oxychloride and other chlorine containing agents, the rearrangement can take place with the formation of 1-chloro-3-nitro-4-oxyisoquinoline (27). This substance contains very reactive functional groups which gives an opportunity of preparing a series of new isoquinoline derivatives (28), which may be capable of possessing physiological activity. So far the wide possibilities of synthesizing new interesting compounds starting from 1-chloro-3-nitro-4-oxyisoquinoline have not yet been exhausted. The rearrangement of the imine of nitroindandione in the presence of concentrated sulfuric acid which gives 1,4-dioxo-3-nitroisoquinoline has also not been sufficiently studied.

The halogenation of the imine of nitroindandione (29) is characteristic in that chlorination and bromination give two completely different products: chlorine replaces only the hydrogen of the oxime group (50) with the formation of 1-chloro-1-nitro-3-nitroindandione-3, but bromine gives a deep rearrangement of the molecule, with the formation of a non-nitroso substance - dibromomethyleneplithalide (51).

The work in the field of nitroindandione is summed up in the monograph "Nitroindandione" (32).

Because indandione-1,3 and its derivatives possess a series of valuable properties, interest was shown in the study of those of its derivatives which have substituents in its benzene ring. In general, these derivatives have

rarely been studied. We began a systematic study of 4,5-dimethoxyindandione-1,3, and also its nitration product 2-nitro-4,5-dimethoxyindandione-1,3, which has much in common with nitroindandione-4,5-dimethoxyninhydrin was obtained, which gives, just like ninhydrin, the characteristic "ninhydrin reaction" with alpha-aminoacids (34).

A study of the analogs of indandione-1-thionaphthene-3-dioxide was started.

Many derivatives of indandione-1,3 are physiologically active compounds. Of these the most widely used is 2-phenylindandione-1,3 which is a valuable blood anticoagulant. A sufficient quantity of this compound was prepared in our laboratories and dispatched for investigation to the Leningrad institute of blood transfusion, and subsequently to various medical establishments. As a result of many years of investigation (36,37) 2-phenylindandione is recognized as a better blood anticoagulant than dicoumarin which up to this time has been used in the Soviet Union, and since 1958 it has been allowed to be used in medical practice under the name of "Phenylin". At first it was produced in the Experimental plant of the Institute of organic synthesis in the Academy of Sciences of the Latvian S.S.R. but nowadays its production is being developed at the Riga chemico-pharmaceutical plant No.3.

The synthesis of phenylin takes place in two stages: first phthalic anhydride condenses with phenylacetic acid in the presence of sodium or potassium acetates, and then the benzalphthalide obtained rearranges, with sodium methoxide in methyl alcohol, to 2-phenyl-indandione-1,3. Thus, the production of phenylin is not difficult, but there are several unpleasant moments: the first stage takes place with the fusing of the components at a high temperature (about 240°), the second necessitates working with metallic sodium. For this reason V. Oshkaya developed a new single-stage synthesis of phenylin by heating phthalic anhydride with phenylacetic acid in acetic anhydride in the presence of triethylamine. The continuous (line production) process of preparing phenylin was developed on these lines: the method may perhaps be applied to the large scale production of phenylin. A certificate of authorship of this invention was obtained.

There are indications that several derivatives of 2-phenylindandione-1,3 are good blood anticoagulants, for example, parachloro- or parabromophenylindandione and others. For this reason we synthesized and studied a series of derivatives of phenylindandione and its analogous compounds. It was shown that the replacement of the active hydrogen in phenylindandione by a halogen or nitro group

also gives an active preparation; replacement by a sulfic group gives a soluble preparation but one deprived of its anticoagulatory activity; the very same effect is observed in the replacement of the active hydrogen by an amino group. In the reaction between formaldehyde and phenylindandione the active hydrogen is replaced by a methoxy group. This 2-methoxy-2 phenylindandione-1,3, according to the investigations of M. N. Koptelov, displays about ten times the activity of phenylin and is distinguished by its milder reaction. The preparation is offered for clinical experiments under the name of "omephene".

In our own time we have established that para-methoxyphenylindandione (anisylindandione) is a good blood anticoagulant. Unfortunately, a more detailed chemotherapeutic study of this preparation was not carried out, but nowadays it has already appeared abroad as a particularly mild-operating blood anticoagulant under the name of "anisidone".

Some very interesting blood anticoagulants were revealed among the indandione derivatives we synthesized recently, for example xanthylindandione, paramethoxybenzylindandione and a number of others. It should be particularly noted that the replacement of the active hydrogen in 2-substituted indandiones by a thiocyanate group readily gives active blood anticoagulants. Derivatives of phenylindandione, containing substituents such as chlorine, bromane, nitro group (39) and methoxy group in the indandione ring, were also studied. Tetrachlorophenylindandione was also prepared.

Of the derivatives of indandione the 2-acylindandiones-1,3 present undoubtable interest; among these are bacteriostatic -like substances, and also very active blood anticoagulants. 2-diphenylacetylindandione-1,3 is especially noted in the latest patent literature. We developed its synthesis (40) and compounds were sent for investigation to the Leningrad institute of blood transfusion. The preparation showed about ten times the activity of phenylin; laboratory experiments were carried out (41). Clinical tests are presently coming to an end, and it will be proposed for introduction into medical practice under the name of "diphenacin".

Diphenylacetylindandione has found yet another wider practical application. It is known that some blood anticoagulants are used successfully for destroying harmful rodents. In this respect diphenylacetylindandione was shown to be particularly valuable in the struggle against rats. For other animals, apart from cats, it was shown to be

comparatively less toxic, and because it is given in the baits in a very diluted form (0.02%) the danger of poisoning other animals is slight. Rats eat this bait readily in the course of several days and almost all die. It is characteristic that rats do not produce any protective reaction to this preparation; they eat more of it, and then, when they have received a fatal dose, death is inevitable. Diphenylacetylindandione was widely studied in the zoological laboratory of the All-Union Institute of Plant Protection (Leningrad), where for practical application a preparation was developed consisting of a mixture of one part of diphenylacetylindandione with 200 parts of corn starch, colored with methylene blue. Such a preparation was called "ratindan" (42). During latter years widespread deratization tests have been carried out with it, in more than 100 collective and state farms in the U.S.S.R. without withdrawing cattle and birds from the location, and not one case of disease or loss among them was noted. Ratindan was also used with success in the deratization of various towns and suburbs, including, by the way, Riga. Since 1958 the complete deratization of Leningrad has been carried out using ratindan. According to professional opinions, ratindan is considered to be the best rodenticide of all those in practical use today. Ratindan is produced in the Experimental plant of the Institute of Organic Synthesis of the Academy of Sciences of the Latvian S.S.R., but the plant is not able to satisfy all the growing demands for this preparation.

Recently V. Zelmen and Z. Krastine synthesized a homolog of diphenylacetylindandione-2-phenyltolylacetylindandione-1,3, the rodenticidal quality of which, according to preliminary tests, is not inferior to diphenylacetylindandione. Derivatives of diphenylacetylindandione, for example its chloro and bromo derivatives (43), were also synthesized and shown to be strong blood anti-coagulants (38).

Trimethylacetylindandione (pivalylindandione) was found to be a good rodenticide. Apart from being a rodenticide it also possessed a phytonicidal reaction.

New methods are being developed for the production of acylindandiones. In several cases the straight-forward acylation of indandione was achieved using acyl chlorides in the presence of anhydrous aluminum chloride in chloroform. Unfortunately diphenylacetylindandione could not successfully be obtained by this method.

Interest was shown in the preparation of 2-substituted indandiones-1,3, in which the phenyl group is somewhat displaced from the indandione group, for example

aralkyliindandiones. Straight alkylation of indandione does not result in monoalkyl products; therefore it was necessary to develop a new method for their production. Indandione very readily condenses with aldehydes, forming arylideneindandiones. A method for the selective hydrogenation of these compounds was successfully developed, using sodium dithionite (hydrosulfite) in an aqueous-alcoholic medium, the ethylenic bond only is hydrogenated and the carbonyl group is unaffected (46,47). Not only are the condensation products of indandione with benzal-, oxy-, methoxy-, and dialkylaminobenzaldehydes efficiently hydrogenated, but also the condensation products with aldehydes of polycyclic systems, and also with the aldehydes of thiophene, furan and nitrofuran. T. Dimpus showed that even better yields are obtained by catalytic hydrogenation in the presence of a nickel shell. A large group of aralkyliindandiones became accessible, which themselves present a definite interest, and are capable of giving a series of interesting derivatives.

Depending upon the reaction conditions indandiones can condense with aldehydes or carbonyl compounds in general, not only in a 1:1 but also in a 2:1 ratio. In the latter case compounds are obtained containing two indandione groups at one carbon atom. Such geminal compounds are formed principally from aliphatic aldehydes, acenaphthenequinones, phenanthrenequinones and others, whereas aromatic aldehydes frequently give both groups of these compounds, the arylideneindandione first produced, adds on a second molecule of indandione. This addition compound is readily obtained, when the molecule contains either an unsubstituted aryl, or a substituted electrophilic group, but when nucleophilic substituents are present the arylideneindandiones do not undergo further addition of indandione (48-53).

The geminal indandione compounds are of interest because during the reaction with dehydrating substances they readily "split off" a water molecule from their enolic forms and yield pyran derivatives. With the action of ammonia or amines, pyrans replace the bridge oxygen by nitrogen and the corresponding dihydropyridine derivatives are formed; these are readily oxidized to pyridine derivatives.

The replacement of oxygen in pyran by nitrogen is carried out with varying degrees of ease in some cases with the action of alcoholic ammonia, in others just by reaction with liquid ammonia in a sealed ampoule. It was found that in obtaining dihydropyridines (and pyridines) the phase

involving pyrans could be bypassed. Geminal indandione derivatives, when warmed with ammonium acetate in ice cold acetic acid, at once give the corresponding dihydropyridines (54,55). But since geminal indandione derivatives are readily formed from carbonyl compounds and indandione, the straight-forward warming of carbonyl compounds and indandione (or an arylideneindandione) with ammonium acetate in ice cold acetic acid at once gives the corresponding dihydropyridines (56,57). Thus a very simple path is open for obtaining complex multinuclear heterocyclic compounds (derivatives of dibenzoylenepyrrans and pyridines), with a structure similar to the skeleton of the alkaloids, from easily accessible compounds. If the carbonyl compounds are acenaphthenequinone or phenanthrenequinone, then the heterocyclic compounds obtained have more of a spirane structure.

While studying the oxidation of acenaphthene-spiro-dibenzoylenepyridine, G. Dubur explained that the rupture of the ring by the carbonyl group of the acenaphthene ring takes place with the formation of dibenzoylenepyridylnaphthoic. The amides of this acid were found to be very interesting derivatives. Those which contain available hydrogen in the amino group dissolve in alkali to give an intense violet color, resembling the alkaline solutions of the analogous dihydropyridines. This very unexpected reaction was elucidated: the amide group in an alkaline medium undergoes an intramolecular addition with the pyridine ring, with the formation of a new ring, and a new dihydropyridine derivative; upon acidification this ring is again opened with the formation of the usual acid amide. This conversion was confirmed by studying the I.R. and U.V. spectra.

Since dimedon also gives geminal bis-dimedonyl compounds, it was interesting to find out, if it was impossible for these compounds also to cyclize, with the reaction of ammonium acetate, to the appropriate nitrogen-containing heterocyclics. E. Stankevich demonstrated that the condensation products of dimedon and formaldehyde p-nitro and p-dimethylaminobenzaldehyde under these reaction conditions give the corresponding tetramethyldecahydroacridinediones which are easily oxidized to octa-hydroacridinediones. The addition compound of dimedon and benzalindandione was studied with the aim of obtaining asymmetrical compounds containing one indandione group and one dimedon group. Such an addition compound could not be obtained. But, by comparison, the imine of dimedon readily undergoes the addition reaction, and the addition product readily cyclizes with the formation of a complex nitrogen-

containing heterocycle, which gives the possibility of the formation of unique multinuclear heterocyclic compounds, among which physiologically active substances are possible.

Simultaneously, the reaction of ammonium acetate on aryl and alkylindandiones was studied. The starting point of all this work was obtaining the imine of nitroindandione by the action of ammonium acetate on nitroindandione (58). Later the imines of 2-phenylindandione-1,3 and 2-methyl-indandione-1,3, and others, were prepared and studied. By systematically studying their U.V. and I.R. spectra, J. Freymans established that the imines exist in imino-enol forms, but phenylimines (anils) exist in the keto-enamine form.

In recent years it has been established that the many 2-amino-2-arylindandiones, synthesized by A. Aren at the Faculty of Chemistry of the Riga Polytechnical Institute, possess clearly expressed physiological activity; they are narcotics, analgesics, spasmolytics, and others. Systematic investigations of these substances carried out by S. German in the chemico-therapeutic sector of the Institute of organic synthesis of the Academy of Sciences of the Latvian S.S.R. showed that they possess pronounced pharmacological activity in connection with their influence on the central nervous system. Many 2-alkylamino and 2-dialkylamino-2-phenylindandiones-1,3 show narcotic activity. In doses, not large enough to alter the behavior of animals, these narcotically acting substances show analgesic activity. The narcotic activity of all the compounds studied was shown to be lower than the corresponding activity of the barbiturates, but since the latter are more toxic in relation to the scope of their narcotic activity they are inferior to some of the 2-amino-2-phenylindandione-1,3. The chlorohydrate of 2-methylamino-2-phenylindandione-1,3, "metamphidone" was shown to be the most interesting of the compounds studied. It was expedient to test it in the clinic as an intravenous, briefly-operating narcotic, and also as a soporific when taken internally.

It was found that the derivatives of 2-amino-2-phenylindandione-1,3, in doses significantly smaller than for narcotics, show an anti-convulsive reaction with respect to spasms induced by both the administration of corasole and the effect of electric current. The most interesting anti-convulsive substance was found to be the chlorohydrate of 2-ethylamino-2-phenylindandione-1,3- "etamphone". It was expedient to test it in the clinic as a cure for epilepsy and also for hyperkinesis of strio-pallidal origin.

In connection with the valuable properties of the

amino derivatives of 2-phenylindandione-1,3, a study of the amino derivatives of the 3-alkylindandiones-1,3 (J. Ozol) was started. Several other physiologically active compounds were found among them. Work is also being carried out on the combination of an indandione grouping with barbituric acid (U. Pelcher).

It was interesting to prepare branched amino-derivatives of 2-substituted indandiones, in which the amino group is somewhat displaced from the indandione group. With that end in view Y. Dregeries is studying 2-p-aminoethyl-2-phenylindandione-1,3, among which several active substances are also found.

With the object of obtaining amino derivatives of indandiones having a longer branched group in position 2, in addition to containing a carbonyl group, E. Ozol is studying 2-(phenacylbenzyl)-indandione-1,3.

Finally, E. Grenom has started a systematic study of cyclopentene-4-dione-1,3, as a prototype of indandione compounds.

Work on beta-diketones in the Academy of Sciences of the Latvian S.S.R. leads to close contact with the association of the chair of organic chemistry of the Faculty of Chemistry of the Riga Polytechnical Institute (prior to 1958 the Latvian State University) where valuable results have also been obtained. (For a brief review of these works and also the corresponding bibliography see (60).)

Thus, the Academy of Sciences of the Latvian S.S.R. has, during its existence, solved a series of theoretical problems in the beta-diketone field and has elucidated the reactive capability of many compounds in this group. A series of new analytical reactions have been proposed, some of which have already gone into practice, and the synthesis of the necessary reagents has been introduced into plant production (nitroindandione and bindone at the Voykov plant Moscow). Phenylindandione (phenylin), the anticoagulant, was studied and introduced into medical practice; the clinical tests of another anticoagulant diphenylacetyl-indandione (diphenicin) are complete. The rodenticide ratindan has found a wide application, and, according to professional opinion, is considered the most effective and safest rodenticide in use today. All the last three preparations are produced at the experimental plant of the Institute of organic synthesis of the Academy of Sciences of the Latvian S.S.R. An entire series of new blood anti-coagulants have been demonstrated. A new group of physiologically active substances - the aminoindandiones have been widely studied, from which two preparations have been

recommended for clinical tests, a narcotic ("metamphidone") and an anti-convulsive agent ("entamphone"). A series of further active substances in this group have been revealed. A 'path' from indandione to isoquinoline derivatives was developed, which provides new opportunities for synthesis in this physiologically important class of compounds. A method for the synthesis of complex multinuclear heterocyclic compounds was developed, starting from indandione, carbonyl compounds and ammonium acetate.

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INVESTIGATIONS OF THE CHEMISTRY OF WOOD AND ITS COMPONENTS  
AS A THEORETICAL BASIS FOR THE CHEMICAL TECHNOLOGY OF WOOD.

by P. Odintsov

Pages 193-202

Studies in the field of wood chemistry in Soviet Latvia really only began after the foundation of the Latvian Academy of Sciences [1] in 1946.

The cell walls are composed of ligneous material not only in trees, but also in all the higher plants as well. Wood chemistry, therefore, extends far beyond the study of wood in the usual sense of the word. Wood chemistry deals not only with the study of the substances formed in dead cell walls, and the precise structure of the latter, but also with the synthesis of these substances in the formation of cell walls during plant growth.

The processing of wood, in the widest sense of the word, and its derivatives produces a large number of products which are extremely important for Latvia's economy. It is stated in the resolutions of the controlling agencies that special attention should be paid to the complex utilization of wood derivatives and various agricultural products. This type of raw material renews itself each year, and if used rationally is not liable to become exhausted, as is the case with some mineral resources. The rational use of plant resources requires the elaboration of technical processes for obtaining monomers and high polymers, which in turn requires the solution of a number of theoretical problems.

In the chemical processing of wood for the purpose of obtaining cellulose, sugars or furfurole, the reactions take place in alkali or acid solutions. In solutions of this type, the wood and the intermediate and end products are in a swollen condition. The reactions take place both at the external surfaces of the cell walls and in the cell wall capillaries and on their surface. In order to gain an accurate picture of the development of the reaction, therefore, we must know the extent of this swelling of the wood and its components, as

well as the specific surface, and the size of the capillaries reacting. In the case of the hydrolysis of wood by concentrated acids, one must know the swelling limit, after which polysaccharides begin to dissolve.

The results presented in this paper were obtained from research by members of the Institute for Forestry Problems and Wood Chemistry, or research in which they have directly participated.

Two methods were evolved at the Institute for the hydrolysis of raw material containing cellulose with concentrated  $H_2SO_4$ . In one variant hydrolysis is carried out by comparatively large quantities of acid (2-6%), and in the other by small quantities (0.5-0.1  $H_2SO_4$  monohydrate of the weight of raw material) with simultaneous grinding (7-20%). Sugar yield in both variants is approximately the same as the theoretical estimate. Hydrolysis technology is not given here, as it is described in the paper by A. I. Kal'nin'sh (21).

The swelling of wood and wood components was studied in different solvents and solutions: in water, in organic solvents, in concentrated  $H_2SO_4$  and other acids, as well as in  $H_2SO_4$  in the presence of sugars (22-33). To determine the part played in the swelling of cell walls by its component parts, the swelling of cellulose, lignin, and hemicelluloses was studied. So as to obtain uniform results the work was carried out with a single type of wood. For these studies sprucewood was used; our conclusions, however, can be extended to other annual and perennial plants. The degree of swelling is usually calculated on the basis of the increase in fibre width. This method, however, is unsuitable for the exact determination of swelling in cell walls, since, according to our observations (23, 24, 25, 28, 29), a reduction in the cell cavity takes place during swelling. Therefore, in addition to the overall width of the fibre, the thickness of the cell walls, and the width of the cavity must be measured.

Cellulose fibre isolated from holocellulose by mild hydrolysis swells in water as follows: thickness of the walls increases by 18.1%, the fibre cavity expands by 22.8%, and the overall width of the fibre increases by 21.1% (27). As far as is known the swelling of holocellulose has not been studied so far. We have shown that it swells much more in water than cellulose. Walls thicken by 50%, the overall width of the fibre increases by 32.3%, and the cavity by a total of 19%. The external layer, therefore, in the holocellulose fibre has a pronounced restrictive effect, even with swelling in water, while with cellulose it is only significant with swelling in acid or alkali (28). The swelling of isolated spruce tracheids in water occupies an intermediate position between the swelling of cellulose and holocellulose, giving 22.3% for the overall width of the fibre, 31.6% for the walls, and 11.3% for the cavity (30).

The study of the swelling of wood and wood components in alkali

and, especially, concentrated acid solutions is of great theoretical and practical interest. It was noted that the addition of glucose sharply reduces the hydrolyzing potential of concentrated acid [734.7]. In the hydrolysis of plant materials sugars are formed in very large quantities, and produce concentrated solutions. A systematic study was therefore made of swelling in pure concentrated  $H_2SO_4$  and in acid in the presence of sugars.

In the study of the swelling of cellulose and other wood components 64.5%  $H_2SO_4$  was used. This acid dissolves cellulose quickly and is at the same time close to the boundary (60%), below which cellulose will hardly dissolve. According to our studies, the effect of sugars on swelling is to bind the acid [724.7]. The addition of even small quantities of glucose, therefore, to 64.5%  $H_2SO_4$  has a strong effect on the swelling of fibres. In these researches glucose solutions were used with 2-10 moles acid/l mole glucose.

One is struck by the sharp difference in the swelling of cellulose and holocellulose fibre. In solutions with 2-8 moles acid/l mole glucose, holocellulose fibre walls swell three times as much as those of cellulose. The increase in width of the holocellulose fibre, however, only exceeds that of the cellulose fibre by 1.4 times. The fibre cavity tends to disappear in proportion to the reduction in glucose concentration. These facts emphasize the role of hemicellulose on the one hand, and the great strength of the outer fibre layer which restricts expansion, on the other. Calculations show that hemicellulose in water swells 4.3 times more than cellulose [735.7].

According to our data, expansion of the fibre in swelling is restricted by the cambial membrane, which when swollen has a thickness of 0.2 u. The cambial layer has a reticulate structure, which is especially conspicuous when the holocellulose is heated [735.7]. It depends only slightly when the fibre swells, and though it gives a color reaction to the cellulose, it is more difficult to hydrolyze than second layer cellulose. The cambial layer is extremely strong, especially at the ends of fibres. The ends of fibres do not disrupt even when the swelling is extensive. When the methods we have developed are used, with swelling of the fibre, the cambial membrane forms spiral bands encircling the whole fibre.

Study of swelling in cross sections of wood gives very clear data on the course of swelling [722, 25, 30]. With  $H_2SO_4$  concentrations up to 55% the swelling of all cells in a cross section is almost uniform. In 65%  $H_2SO_4$  the tracheid cavities disappear, and the section then quickly becomes macerated. The pressure of swelling substance on the external walls is so high that the intercellular substance is disrupted. The presence of sugars in the acid, both in the case of cellulose and holocellulose, depresses the swelling of the wood. The study of the swelling of wood in acid throws light on

the phenomenon of the anisotropic shrinkage of wood [30], which has not so far been completely explained. Frey-Wissling [36], in determining the importance of shrinkage and swelling in anisotropy, attributes it to the middle lamina. If conditions are selected in which hemicelluloses are dissolved following swelling of wood, while the lignin and cellulose remain unchanged, the role of hemicelluloses in the shrinkage of wood can be determined. Frey-Wissling greatly exaggerated the role of the middle lamella. According to our calculations, the part played by it in swelling and shrinkage amounts to 10%, while 90% is attributable to the secondary layer [30].

Wood is composed of up to 30% lignin, so that the study of how lignin swells is of great interest, especially for hydrolytic production. Little work has been done on the swelling of lignin, while the methods used give rise to doubts [37]. According to our data, sulfuric acid lignin isolated from wood swells in water and organic solvents several times more than is indicated in the literature. It swells in water almost to the same extent as cellulose, though the latter, according to the literary data, should swell 10-12 times more than lignin [32]. Lignin swells very pronouncedly in concentrated  $H_2SO_4$  (up to 280%). Addition of sugars to the acid reduces the extent to which lignin swells [32, 34, 25].

The gradual removal from wood of the hemicelluloses and cellulose leads to the formation of cellolignin and lignin in the same quantities as the initial wood. Even when the acid is water extracted, the quantity of cellolignin and lignin is scarcely reduced. This shows that the capillaries in which the wood polysaccharides were distributed prior to hydrolysis, were preserved in the cellolignin and lignin. These data have made it possible to gain a deeper understanding of the processes of wood hydrolysis by concentrated acids. It should be noted that the longitudinal swelling of lignin in concentrated acid is less than the transverse. This is a possible indication of a regular distribution of molecules or lignin lamellae along the wood fibre axis.

As already mentioned, the reactions in swollen cell walls and their components occur in the capillaries and on their surface. The specific surface, therefore, determines the rate of lignin reaction and dissolution in producing cellulose, and the rate of cellulose and hemicellulose hydrolysis in saccharification, as well as the rate of esterification reactions, and of other conversions. Furthermore, the study of the internal surface by the vapor and gas absorption method makes it possible to estimate the structure of the capillary system, and gives valuable results for assessing the processes which take place in wood storage.

The study of water and benzene vapor absorption was made with wood, cellulose, holocellulose, cellolignin, and lignins obtained by different methods [38-43]. The study of dry substances gives scarcely any results, as the capillary system is closed. Swollen

substances must be used in work to determine the specific surfaces, as the cell walls in living plants have max. swelling and reactions in technological processes take place in liquid media, most frequently in aqueous solutions.

The specific surfaces of cellulose [38], holocellulose [39], cuproxam lignin [40], cellolignin [41], and wood [42] were determined by studying their water vapor absorption. These equalled 158, 249, 205, 186, and  $218 \text{ m}^2$  respectively. The specific surface of the hemicelluloses, assessed on the basis of the specific surface of cellulose and holocellulose, was  $443 \text{ m}^2$ , and on the basis of the assessment of the specific surface of wood, cellulose, and lignin- $310 \text{ m}^2$ .

We attribute this difference in the specific surfaces of the hemicelluloses to their being chemically bound with lignin and partly with cellulose in the wood. This confirms our work on the splitting of the ligninocarbohydrate wood complex under the action of enzymes of the fungus Coniophora cerebella, of thermophilic cellulose bacteria, soil bacteria of the genus Mixococcus citophaga, and emulsin. Under enzyme action, several phenolic hydroxyls of lignin are released which were linked with carbohydrates [44]. The specific surface of wood and wood components as the result of alternate moistening and drying over three years gradually decreased.

As described above, the capillary system of wood and wood components was studied during swelling and water vapor absorption. The most promising results were obtained by replacing the water in the capillaries of swollen wood with benzene [43]. According to the data from the last work, the internal surface of wood is estimated at

$284 \text{ m}^2/\text{g}$ , that of holocellulose at  $468 \text{ m}^2/\text{g}$ , and that of partly hydrolyzed holocellulose at  $385 \text{ m}^2/\text{g}$ . The volume of pores in holocellulose is equal to  $0.5425 \text{ ml/g}$ , and in hydrolyzed holocellulose to  $0.4106 \text{ ml/g}$ .

Work on swelling in concentrated  $\text{H}_2\text{SO}_4$ , on the determination of the specific surface, and on the structure of cell walls has shown that the process of hydrolysis under the action of concentrated acids takes place in several stages. The acid penetrates the cell cavities and causes the cell walls to swell. As a consequence the cavities close up. Sugars are formed in hydrolysis, which reduce the pressure of swelling, and the cambial layer is not disrupted, as it is more resistant to hydrolysis than the cellulose in the other wall layers. Maceration of pieces of wood therefore does not take place. Moreover, the presence of sugars strongly reduces the rate of hydrolysis of the remaining polysaccharides. When the sugars are extracted from the pieces of wood by diffusion, there is a gradual hydrolysis of the cellulose, and finally the cambial membrane is hydrolyzed, though at this time the pressure from swelling is so slight that the connections

between neighbouring cells are not disrupted [30-33].

The process is different in the hydrolysis of cellulose and materials containing cellulose with small quantities of concentrated acid. There is such a small quantity of acid present that it cannot fill the cell cavity, and grinding of the material with the acid is needed for its dissemination. Hydrolysis of viscose cotton cellulose [45] at a module of 0.3, 0.2 and 0.1 gives ca 99% glucose yield. It was shown that grinding should not be started until the hydrolysis reaction in the grinding apparatus is complete. The hydrolysis reaction will also continue after grinding; for example, when storing material in powder form at normal temp. for 30 days, or when heating it at 80° for 1 hour. No decline in sugars is noted during this period. As the hydrolyzate in powder form can be stored for a long period, hydrolysis can be carried out at the sites where the wood or agricultural waste products are stocked, while dry hard hydrolyzate should be transferred to the central factory for sugar processing. The temp. coefficient for the reaction rate is 3, which excludes diffusion playing a major role in the process. The data obtained in the hydrolysis of cellulose have completely confirmed the results of earlier work on the hydrolysis of wood and agricultural waste products [33, 46, 49].

The process of hydrolysis takes place as follows: the acid during grinding is disseminated into the material containing the cellulose and is adsorbed by it. Further adsorption takes place in chemosorption with the formation of oxonium compounds. The formation of these latter is more rapid than their disintegration with the formation of cellulose fragments with a shorter chain. Following the grinding process, therefore, the decomposition reaction of the oxonium compounds takes place with a temp. coefficient of 3.

To complete our review of the hydrolysis of wood polysaccharides, it must be stated that the hydrolysis rate is not constant (as one might expect), but in all circumstances it takes place in a minimum time. This was observed in the case of hydrolysis of spruce, birch, and holocellulose [50, 57]. Such a process of reaction for pentosans is due to their varied distribution in the depth of the cell walls, so that the last portion of pentosans hydrolyze under strong swelling of the cellulose. The min. reaction rate noted in cellulose hydrolysis is due, according to our data, to the dissolving of the cellulose in acid both as free molecules and as mycelia. They are quickly decomposed into molecules, which are hydrolyzed to sugars. Lignin somewhat reduces the hydrolysis rate for pentosans, basically at the expense of their mechanical defence against penetration by the acid. The importance of the data obtained on the fine structure of cell walls is exemplified in the case of the hydrolysis of wood and wood components by concentrated acids. These data, however, can also serve to elucidate a series of other technological processes: boiling of cellulose, the antiseptic treatment of wood, etc.

Between 1946 and 1960 scientists belonging to the Academy of Sciences of the Latvian S. S. R. have made a major contribution to wood chemistry extending beyond the fields referred to above. A considerable number of studies, for instance, has been devoted to lignin. Special attention has been paid to the study of its variability in the course of isolation from wood by different methods.

For a long time it has been maintained that the gentlest method for isolating lignin is the biochemical procedure of decomposing the wood polysaccharides. However, it has been demonstrated / 57, 59 / that the lignin, as well as the polysaccharides, changes under the action of the fungus *C. cerebella*. Methoxyl groups and carbohydrates are detached from the lignin under the action of the enzymes of the fungus, as a result of which a single free phenolic group appears per ten elementary lignin units. This confirms the work of Shishkova / 44 / on the existence of a chemical link between lignin and the carbohydrates. A carboxyl group per five elementary units is formed under the action of the fungus in biolignin, which is the basis for the theory of the derivation of the humins from lignin. The probability of the presence in lignin of a carbonyl group was also demonstrated.

Studies have also been made of the effect on lignin solutions of acid, alkali, and neutral solvents, used in obtaining sugars and cellulose from wood.

It was established / 55, 60 / that the solubility of lignin from birch in concentrated  $H_2SO_4$  depends on the acid conc., temp., and reaction duration. In opt. conditions up to 62% of the total lignin in the wood is dissolved. It was also shown that the easily soluble part of lignin, considered as polyuronide / 66 / by some scientists, is an aromatic substance, not a carbohydrate. The effect on lignin of soda, sulfate, and hydrosulfate solutions in the conditions for obtaining cellulose / 62, 66 / was also studied. It was shown that native lignin per five elementary units contained one carbonyl group, free to give acid hydroxyl, and one free phenolic hydroxyl group per eight elementary units. The carboxyl groups are absent. In the process of alkali boiling the number of phenolic hydroxyls increases fourfold, and a carboxyl group appears. Only a quarter of the total acid hydroxyls is present in the enol hydroxyls.

The study of lignin obtained by extraction with alkali provides valuable data on the nature of lignin, but, as can be seen from the works cited, profound chemical changes in the lignin molecules take place in extraction. The action of neutral solvents was studied, taking the effect of a solution of sodium xylol sulfo acid (a hydro-tropic solvent) on aspen lignin / 67, 71 / as an example. It was shown that a low molecular lignin component was present in the wood. Lignin fractions with varying solubility were obtained by boiling in stages. The solubility of extracted lignins in sulfite liquor is usually accepted as a measure of changes in lignin. Thus, according

to our data [72, 73] after prehydrolysis of the wood, lignin becomes soluble in sulfite liquor. According to the data of the same authors cuproxam lignin and bio lignin are almost insoluble in sulfite liquor. With hydrotropic lignin it was successfully demonstrated that the insolubility of the lignin extracted was dependent on its colloid chemical conditions, as well as on the chemical changes taking place in the lignin. When boiling unprecipitated hydrotropic lignin, therefore, almost all the lignin passes into the solution, whereas with preliminarily precipitated lignin, 20% in all dissolves.

Studies of thermic action on lignin for the purpose of ascertaining whether valuable products such as phenol, aromatic aldehydes and acids could be obtained from lignin were carried in different directions. In studying the thermolysis of lignin produced by treating wood with concentrated  $H_2SO_4$ , it was shown that over 16% tar, rich in phenolic compounds, could be obtained [74]. With thermolysis of alkali lignin [75] the yield of tar precipitated was the same but 80% of it consisted of phenols and carboxylic compounds.

Studies of the hydrogenetic splitting of lignin in the boiling of wood with a hydrotropic solvent in an H atmosphere in the presence of a nickel catalyst made to produce aromatic monomers showed that in this case the hydrogenation process is dependent on the pH of the solution: the process is accelerated when the pH is reduced, and retarded when it is raised. It was also demonstrated that the splitting of lignin is marked at temps. over  $170^{\circ}C$  [76].

In addition to the work on lignin, systematic studies are also being made of the processes in the thermal decomposition of other wood components for the purpose of developing the theoretical principles for a new pyrolysis of wood in stages. Researches carried out at the Institute gave the first indication of the possible controlled thermal decomposition of cellolignins [77, 78]. In this process the cellulose decomposes, levoglucosane (30-40% yield) being predominantly formed, and phenol products are obtained in lieu of lignin. Studies of the thermolysis of the hemicelluloses especially of xylan [79, 86], showed that during thermal decomposition of wood up to 70% of the total quantity of tar precipitate, up to 5% of the soluble tar, and 30% of the total quantity of volatile acids may be formed in the H current at the expense of xylan. Pentosans were shown to play a prominent role in the formation of aromatic compounds in the pyrolysis of wood; a plan is presented of the mechanism of the pyrogenetic decomposition of xylan. Further researches determined how xylan and xylose behave in the course of thermal treatment in different conditions. In particular, the dehydration processes of the initial monomer radicals developed were shown to inhibit the conversion of xylan to furfurole in thermolysis.

Problems of the formation of the components of the cell wall and its fine structure have occupied a major place in the scientific

researches of the Institute for Wood Chemistry.

In studies on the variability of the quantitative correlation of the cell wall components using quick growing poplar as the example, the fluctuations in the correlation of cellulose, lignin, polyuronic acids as well as of the extractable substances were shown [87] to be very considerable, and to depend on the length of the day, and the growth temp. and duration. Cellulose and protein content increases with rise in temp.; shortening of the natural day produces an increase in extractable substances and a reduction in the quantity of lignin.

Almost now recognizes that lignin forms in plant tissue by polymerization and condensation of aromatic compounds of the phenyl-propane series. It has not, however, been finally established yet how the actual predecessors of lignin are formed, and how they are subsequently converted.

Researches by a number of authors have explained the nature of intermediate lignin-like compounds.

Researches made at the Institute [88] revealed the presence of similar aromatic compounds in young poplar shoots; it was established that their accumulation is dependent on the length of exposure to light, and the conditions were established for their conversion to lignin by polymerization and condensation.

However, the discovery of the last stage in lignin formation has still not solved the problem of how low molecular aromatic compounds originate in the plant, for example, form monosaccharides, as many authors suggest.

Confirmation was obtained with a method based on the use of marked atoms of the hypotheses on the participation of monosaccharides, pentoses and glucose in the process of lignin formation [89, 91] via intermediate monomeric aromatic compounds. The authors established that the conversion of monoses to lignin begins in the first hours following their introduction into the plant and continues for over 72 hours at a varying rate. Here the conversion of glucose is more intense than that of pentose.

Lignin in wood was shown by further researches not to be uniform, and may change under the influence of growing conditions [92]. However, all lignin, both soluble and insoluble, in the course of formation, is of an aromatic nature, as shown by the example of birch lignin [93], and by that of lignin from poplar wood [92].

As stated above, these researches refute the contention that soluble lignin is of a polyuronic nature.

To conclude, it can be stated that in the first 20 years of Soviet Latvia some successes have been achieved by our scientists in the field of the chemistry of wood and wood components, as well as in that of their conversion in the course of the chemical treatment of plant materials.

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## GEOLOGY OF SOVIET LATVIA FOR 20 YEARS

By K. Springis

Pages 203-212

Soviet Latvia is 20 years old. In spite of enormous upheavals due to the bloody war against the German fascist aggressors, in this historically very short period the entire economy of the republic has been completely transformed and its productivity has increased ten times. Together with the development of the economy as a whole, the geological investigation of the territory of the republic has been pushed forward at a no less rapid pace. In bourgeois Latvia, before 1940, the geological service to industry consisted in carrying out small isolated assignments for individual businesses, the needs of transport were taken care of by a single geologist and research work was in the hands of five members of the geology department of the Faculty of Natural Science of the university headed by Prof. E. Kraus. Certain very limited mineralogical investigations were carried out in the department of mineralogy of the Chemistry Faculty by three or four workers headed by Prof. B. Popov.

The Institute for the Investigation of Useful Minerals, founded in 1936 with a staff of 20 geologists and 15 technicians, was occupied in investigating deposits of building materials. The work of the Institute was supervised by K. Bamberg and A. Tramdakh: the investigation of peat bogs was in the hands of P. Nomals and the hydrogeological work was directed by Ya. Vitins. None of the work was sufficiently purposeful and the research was ordinarily left to the private initiative of the geologists themselves.

With the establishment of Soviet rule in Latvia, the volume of work and the finances of the Institute for the Invest-

igation of Useful Minerals were sharply increased, the range of study was expanded and given a definite direction - the provision of domestic mineral supplies for the national economy. However, during the war almost all geological work was devoted to the needs of the occupiers, not to those of the national economy.

The planned activities of the Institute were resumed at the end of 1944, immediately after the liberation of Riga from the fascist aggressors. Since then geological investigations have expanded continuously in range and volume. The expansion in the work on mineral surveys was accompanied by a similar and equally systematic expansion in scientific research work within the republic. In 1946 when the Academy of Sciences of the Latvian S.S.R. was founded, the Institute for the Investigation of Useful Minerals was reorganized as the Institute of Geology and Geography and incorporated in the Academy. From the very beginning this Institute had a staff of about 100, engaged in tackling both production and research problems. At the same time a whole series of planning organizations created their own geological groups, entrusted with carrying out geological work in connection with planned construction. Several special drilling units were also set up; these were charged with drilling artesian wells to provide water for industrial establishments and the population in general.

By 1950 more than 300 people were working for the Institute of Geology and Geography, but the increase in the volume of geological work far exceeded the capacity of the Institute. Therefore, at the beginning of 1953, production work was transferred to a special geological-prospecting section of the republic's planning institute, and, somewhat later, the drilling work was given to a newly organized combine "Latburvod". The decrees of the XX Congress of the CP of the USSR called for an unprecedented advance in industrial and municipal construction. An adequate supply of raw materials could only be ensured by a corresponding expansion in geological survey work.

In connection with the creation in 1957 of the Latvian economic region and the reorganization of the Geological Service throughout the Soviet Union, the Council of Ministers of the Latvian S.S.R. in Riga organized the Board of Geology and Mineral Resources the task of which is to make sure that Latvian industry is never short of raw materials. At the same time the geological sections of many planning institutes substantially extended their operations and were fitted out with new equipment and laboratory support. Besides the local agencies, many organizations based in Moscow and Leningrad have carried out a great deal of work in the republic, connected both with general geology and mineral and hydrological surveys.

The result of all this work is a huge mass of data which

has thrown much light on the geological history and structure of the country, the distribution and quality of useful minerals, hydrogeological and engineering problems and a variety of other topics of a geological nature. The development of research has naturally led to its being subdivided into various specializations, permitting a profounder treatment of individual subjects. Below, the geological work being carried out in the republic is briefly surveyed under a number of main headings.

### Stratigraphy and Palaeontology

The development of the science of stratigraphy within the territory of the Latvian S.S.R. has occupied numerous investigators employed by a number of different institutions. As is well known, the territory of the republic is characterized by extensive outcrops of Devonian rocks and these have been the principal object of study. The stratigraphy of the Devonian has been treated in a number of works by P. Liepins, R. Gekker, L. Petrov and other geologists, who have isolated new formations of this age and have refined previous systems of classification.

P. Liepins has undertaken a careful study of faunal remains (brachiopods and armored fish), in which he has been supported by D. Obruchev (ichthyofauna). These investigations have made it possible to demonstrate the presence in a number of places of deposits of the Eifelian stage as well as of certain Lower Devonian deposits previously unknown on the territory of the republic. The same material has made possible a more reliable delimitation of the middle and upper sections of the system, including in the latter deposits of the lower series of mottled formations of the system. The limits of the Frasnian and Famennian stages of the Upper Devonian have also been established on the basis of palaeontological evidence.

The investigations of faunal remains have been accompanied by studies of the composition of the Devonian deposits. The composition and structure of the arenaceous-argillaceous strata have been elucidated in works by E. Lauenkrapch, L. Lusin', V. Belousova, L. Rukhin and a number of other investigators, who have demonstrated differences in the quantitative conditions of mineral association in different formations, even where the outward appearance is the same.

V. Ozolin' has been studying spore and pollen complexes in Devonian deposits for a number of years. E. Lauenkrapch, P. Ul'st, V. Ozolin' and L. Savvaitova are studying the carbonaceous rocks.

All these investigations have been assisted by widespread drilling, carried out by the All-Union scientific research institute of petroleum geology. The data obtained from these

investigations have made it possible for P. Liepins and R. Gekken to prepare summaries of Devonian stratigraphy and a series of reports of a similar nature relating to various questions of the geology of the republic. Lithological and facies maps have also been compiled for a number of stratigraphical horizons of the Devonian of the Baltic region. The stratigraphical systems of the Devonian of the Baltic republics have been correlated with strata of the same age belonging to other regions of the main Devonian field and certain horizons of the central field.

The extensiveness of the drilling has also made it possible to clarify problems relating to the stratigraphy and lithology of Pre-Devonian strata, previously almost unknown within the territory of the republic. B. Sokolov, G. Dikenshteyn, R. Ul'st, M. Obut et al. have described these strata at a number of points in the republic. In the near future this work will be substantially broadened in connection with oil-prospecting work in early Palaeozoic rocks.

P. Liepins, V. Ozolin', A. Skrastina, V. Krops and others have also studied the age, composition, structure and distribution of Permian limestones in the western part of the republic. The exact age of the limestones has been established. Moreover, the region in which they are found has been shown to be palaeogeographically connected with neighboring regions in which rocks of the same age occur. Triassic deposits in the form of so-called "Purmalskiye" marls have been described by P. Liepins and E. Lyutkevich. The stratigraphical context of the Jurassic deposits has been established. It has been shown that there are no Carboniferous rocks within the territory of the republic.

The Quaternary deposits that cover the republic in an almost continuous sheet have been just as intensively investigated. In this sheet Glacial and post-Glacial deposits have been identified and studied. Although up to 1940 only two morainic horizons, differing in outward appearance, had been identified, now, in many parts of the republic, we know of not less than four such horizons, in each of which the moraines have their special composition and structure. In 1943, A. Dreymanis, drilling near Rutsava, found three horizons of moraines of different age, separated by intermorainic deposits, the palynological characteristics of which were not entirely clear. After the war, when investigations into a number of outcrops in the basin of the river Vent were resumed, V. Perkons described the cross section of morainic deposits, consisting of three morainic horizons, separated by lacustrine formations with a complex of pollen and spores, characteristic of the Odintsov and Mikulin interglacial periods. Yet another, older horizon of moraines, separated from the moraines of the Dnepr glaciation by a thick series of deposits laid down in running water, was

found in the same drilling zone. Thus, we have here four clearly distinct moraines, probably all belonging to different periods of glaciation.

In exactly the same way, in the basin of the river Daugava and in a number of places in the eastern part of the republic drillings have cut through three, four and even five horizons of moraines, sometimes separated by deposits with plant remains. Together with a very few sites of more or less reliable interglacial deposits (Rutseava, on the river Pesel, Kraslav), we now know of a number of such sites in the basins of the rivers Venta, Daugava, Gauja and Salatsa, in the Lubanskiye lowlands and in other places. The processing of the material continues and there is no doubt that palynological techniques will reveal analogies with the deposits of several well-known interglacial periods.

The material composition of the moraines is being extensively investigated both from the point of view of granulometric, petrographic and mineralogical composition, the amount of carbonate in the various morainic horizons and the distribution of carbonates in the finer-grained parts of the moraines and from the point of view of the petrographic composition of the boulders from different moraines. One of the main problems is to differentiate between the material composition of moraines from different periods of glaciation, so that they can be distinguished and dated at sites where they are in direct contact with each other.

The post-glacial deposits, the formation and distribution of which are linked with the development of the Baltic basin, are being studied in detail. This work includes a study of the history of the main river valleys of the republic and also of the morphology and dynamics of the coastline. Important work is also being done in connection with the freshwater carbonaceous formations of the Holocene and the peat bogs of the republic. The work continues from year to year in ever-increasing volume, but already certain results have been published in a series of works by V. Perksons, K. Springis and A. Savvaitov on glacial deposits, E. Grinberg, V. Ul'st, I. Danilan and T. Bartosh on holocene deposits, M. Mayore and E. Springis on the development of river valleys, V. Stelle, L. Lusin', T. Bartosh and Yu. Abolkalns on floral remains in interglacial and holocene deposits, A. Savvaitov, M. Kraukle et al. on the mineralogical composition of the finer parts of moraines, A. Klyavin' and G. Konshin on the boulders of certain morainic horizons, V. Melnalksnis, I. Danilan, T. Bartosh and Yu. Abolkalns on freshwater calcareous deposits, M. Galenietse on peat, and so on, not to mention a large number of reports on useful minerals of the Quaternary period.

### Tectonics

Generally speaking, the study of the tectonic structure of the territory and the history of its structural development only began after the 2nd World War, since before that we knew only about certain comparatively small-scale, local interruptions in the deposition of the Devonian strata, mainly from the descriptions of N. Delle. Every year the absence of planned and systematic investigation in this field makes itself more keenly felt and therefore it has been allotted a special place in projects for the coming years. The fact is that many problems of general geology (mineral distribution, oil exploration, hydrogeological regionalization, etc.) cannot be solved without a good knowledge of the tectonics of the country and of the history of its structural development. The existing material is inadequate for the needs of the present.

Nevertheless, quite a lot of material dealing with problems of tectonics has already been collected and published. L. Petrov, P. Liepins, N. Kudryavtsev, F. Alekseyev and others have given numerous descriptions of the general structure of the territory. In addition, R. Ul'st and A. Indans have studied the history of structural development. E. Springis and A. Indan are studying local structures and their distribution and morphology.

Manifestations of neotectonic movements have a special scientific and practical value; E. Springis, A. Indans and N. Kovalevskiy have been occupied in studying them. Deformations of the Baltic shoreline have been studied by E. Grinbergs and V. Ul'st. The work that has been carried out indicates especially intense tectonic activity at the end of the Tertiary and in the first half of the Quaternary periods. Direct evidence of the intense upheavals of that time is provided by the deeply incised valleys of the preglacial river network (up to 300 meters), subsequently filled with and buried under glacial formations. Later settlements resulted in the bottoms of these valleys now lying 200 meters below present sea level. These movements were irregular, so that the same rocks appear at different levels in different regions. It is worth noting that upheavals of the Quaternary cover correspond to large thicknesses of glacial formations and elevations of the present-day relief and subsidences to present-day lowlands.

Tectonic movements continued even after the glacial period, as convincingly testified by the deformation of the shoreline of the Baltic basin. In a number of places we find folded structures, each of which was formed and developed considerably after the glacial period. Such structures and their characteristics have been described by A. Indan (Kemera region) and by

E. Springis (basin of the Daugava). This shows that the signs of the participation of quaternary rocks in small-scale local folded structures, observed by N. Delle and attributed by him to glacial tectonics, can now find their place in a general system of neotectonic movements of the earth's crust within the territory of the republic.

### Mineral Deposits

The reconstruction of the war-ruined economy of the republic and its further development at an unprecedented rate presented geologists with the task of providing industry with a sufficient supply of raw materials of the necessary quality. This determined, firstly, the very rapid rate of development of survey work and, secondly, the need for the systematic exploration of new deposits and the reevaluation and classification of existing reserves. All this work relates to the Soviet period, since up to 1940 Latvian mineral deposits had hardly been explored, survey work was confined to the visual evaluation of a few outcrops, either directly by the exploiter or by his geologist, at the best by quite primitive means. Only in the case of freshwater limestones were lists compiled by K. Bamberg. As far as a number of other minerals were concerned, the only thing known about them was a few of their technological properties, determined by E. Rozenshteyn and Yu. Ryduk. In particular, Rozenshteyn established that the Permian limestones were suitable for cement-making. Immediately after the end of the war there began a systematic and planned search for and survey of deposits, particularly in regions closest to centers of industry. Later, this work was extended to the entire territory of the republic, since construction became necessary literally everywhere.

At first, the techniques of surveying and studying minerals and evaluating reserves, commonly used in the Soviet Union, were employed.

In the course of a few years detailed surveys were made of large quantities of clay deposits in the Elgav basin, in the valley of the Daugava, among the argillaceous Devonian strata at Vidzem and in the eastern parts of the republic. Reports on this work have been written by E. Rinks, O. Ron, K. Skrastin, A. Skrastina, F. Pinnis, E. Ul'pe and many other geologists. Dolomite deposits have been surveyed in the basin of the Daugava, along the river Gauja and the river Lielup and in a number of other places in the east of the republic. This work has been carried out under the direction of A. Klyavina, K. Skrastin, K. Berzins and many others. Freshwater limestone deposits have been detected in many areas of the republic.

where they were previously unknown and where they were not even expected. There are more than 800 such deposits and this agriculturally valuable mineral became accessible to every collective farm. They have been described by Ya. Sleynis, V. Staprēns, Yu. Abolkalns and many others.

Several Permian limestone areas in the west of the republic have been explored in detail. The survey work has been carried out by A. Skrastina, Yu. Abolkalns and others; it has ensured the cement and food industries with reserves of high-quality limestone for many years.

For a number of years other investigators have been paying attention to deposits of gravel and shingle, which are widespread throughout the republic. Ya. Sleynis, V. Staprēns, I. Danilans and others have made a big contribution to this work.

Gypsum deposits in the Riga region have been surveyed by F. Bogomolov, Berzins and Ya. Gaylitis. Glass and mold sands have been investigated by F. Pinnis, K. Berzins and K. Yurevich. Their properties have been studied by P. Vitols and V. Kursh. P. Noamlis, R. Druviet, M. Galinietse and others have been engaged in the study of peat deposits.

Bog ore and brown coal deposits without industrial significance have also been investigated.

All the survey work has been accompanied by detailed studies of the technological properties of the raw materials and their suitability for current requirements. The properties studied include the mechanical, chemical and mineralogical compositions, physical properties and technological qualities. All the data relate to laboratory, production and semi-production conditions. E. Vintins, E. Rinks, O. Ron and G. Matisons have been responsible for much of this work. The technological properties of various clays have been investigated by Yu. Byduks, A. Vayvads and B. Gormanis.

Reports on all this work, running into many hundreds, indicate an abundance of high-quality building materials within the territory of the republic and contain all the data needed to plan the extraction of building raw materials and work out the details of their production.

Attempts have also been made to summarize the survey data. Reports of this type have been prepared by N. Ansberg, E. Rinks and Yu. Selitska on clays, A. Klyavina and K. Springis on dolomites, V. Melnalksnis, T. Bartosh, I. Danilan and Yu. Abolkalns on freshwater limestone deposits, V. Staprēns and Ya. Sleynis on sands and gravels and A. Skrastina and F. Bogomolov on gypsums. V. Kursh and V. Platsens have compiled mineral maps for all the administrative regions and the republic as a whole.

At present enough useful minerals have been surveyed to supply the industries of the republic for many years.

Special mention should be accorded to the oil and gas prospecting work within the republic begun in 1946 by the All-Union petroleum institute and now continued by the Geology and Mineral Resources Board of the Council of Ministers of the Latvian S.S.R. This work is connected with deep drilling and has provided a great deal of data on the composition and structure of the early Palaeozoic strata, which do not outcrop at the surface and which have not previously been penetrated by drill holes. At the present time there are a number of boreholes in the republic down to the Lower Palaeozoic, while three have reached the crystalline basement rock. Several other boreholes are at present in process of being carried down to this crystalline foundation.

The results of this work have been reported by N. Kudryavtsev, L. Petrov and M. Peysik.

#### Hydrogeological Work

The hydrogeology of the republic is becoming an ever more important factor in the national economy. It began to be investigated in the early postwar years, when the hydrogeological conditions in Latvia began to be studied by the north-western geological board of the Ministry of Geology and Mineral Resources of the USSR. In a few years a large amount of material had been collected and published in the reports and monographs of M. Zummer. To her work, the first reports of this type, a schematic hydrogeological map of the republic was also attached. Subsequently the work was extended and further material presented by Ya. Ozolin, N. Lavrinovich and others. A number of hydrogeological problems were clarified in the published works of A. Dzenis-Litovskiy, A. Silina-Bekchurin and other authors.

Lately, M. Lavrinovich has given a description of all the most important horizons of underground water and a description of the conditions of formation of ground water in the republic. The territory has been regionalized on a hydrogeological basis.

For a number of years there have been studies of mineral waters, in particular the hydrogen sulfide waters of the spas of Kemeru and Baldone. The most important part of this work was that devoted to a study of the conditions of formation of the hydrogen sulfide waters of the Kemeru region, carried out by the Institute of Geology and Mineral Resources together with the office of the Soyuzgeokaptazhminvod. A. Indans, P. Mikhaylovskiy, P. Pochelin, E. Springis and G. Jacobson participated. The work was the completion of studies begun earlier by Ya. Vintins, K. Tsukermannis and others.

Considerable theoretical and practical value must be attributed to the work of V. Staprens on the laws of migration

of capillary-bound moisture in the aeration zone and on phenomena connected with the filtration of water through stratified layers of soil. M. Matison has carried out a number of studies in the field of hydrochemistry.

The development of the national economy means constant expansion in the field of water supply. In this connection the amount of drilling undertaken by the Board of Geology and Mineral Resources increases from year to year and at present involves the annual drilling of hundreds of wells.

In every hydrogeological investigation an important problem is to establish the conditions of formation of underground water, its quality and range of usefulness. In this connection drilling is always accompanied by water analyses of various kinds and by geological reports on the water-bearing horizons.

#### General Geology of the Republic

The planned study of the general geology of the republic also began just after the 2nd World War. The first survey work was organized by the All-Union scientific research institute for oil exploration in the region of Plyavinyas and Ogre and directed by K. Mironov; there followed work in the Abavskiy region, directed by Ya. Nikitin, and in the Bausskiy region, directed by E. Platonova.

In the course of preparing plans for the construction of a string of hydroelectric stations on the river Daugava, the Institute of Geology and Mineral Resources carried out the survey and mapping of a ten-kilometer strip along the river valley, from the town of Dris to the river mouth. Although the work did not correspond to the conditions laid down for the national grid, it did yield an abundance of material on the geology of the river valley, the lithology of the rocks along its banks, the conditions under which they were laid down, the hydrogeological features of the zone and the engineering possibilities at various points up and down the river. A large number of people collaborated in this project, among them P. Liepins, V. Perkons, A. Klyavin', E. Springis, O. Varfolomeyev, M. Mayore, M. Kurkle, M. Kovalevskiy, V. Ozolin' and A. Yanputnin'.

An area survey was also made of part of the basin of the river Venta, within the limits of which there was established a complete cross section of the glacial deposits; this cross section could be used as a standard for all the adjacent territory. This region has been described by V. Perkons. A detail study has been made of part of the shoreline, characterized by manifestations of the various stages of development of the Baltic basin; these have been described in the works of

V. Ul'st and E. Grinberg. These detailed investigations revealed important tectonic deformations of the shorelines of different stages of the basin, which made it possible to evaluate the latest tectonic movements in this territory.

A number of monographs have been prepared from existing materials on the administrative subdivisions of the republic. Among these it is necessary to note those compiled by A. Indans and Ya. Selitska on the geology of the Riga, Daugavpils and Liepaya Regions.

At present the Board of Geology and Mineral Resources of the Council of Ministers of the Latvian S.S.R. is carrying out a planned geological survey on sheets of international size. The survey is accompanied by a large amount of drilling for mapping purposes, which will no doubt give abundant new material on a high scientific level. A leading part in this work is being played by Ya. Nisans, Ya. Sleynis, A. Gavrilova and G. Mironov.

The geological work is being carried out in parallel with a geophysical survey of the republic. It was begun in 1944 by R. Vitkovskiy and A. Chebrikov, and, after a certain interval, was resumed under the direction of D. Alekseyev. At present the range of this work is being sharply extended; various geophysical methods are being applied to numerous investigations designed to provide new data on the structure of deep-lying strata and tectonic features of the republic.

All the investigations mentioned have been described in collective works now being printed. These are the XXXVIII volume of the "Geology of the USSR", prepared by the Board of Geology and Mineral Resources and a monograph description of the geological structure of the territory of the Latvian S.S.R., prepared by the Institute of Geology and Minerals in the Latvian tongue. These two collective works will be the first complete and comprehensive scientific reports on the geology of the republic.

### Conclusions

In a short review it is not even possible to enumerate all the geological work that has been and is being carried out in the republic, not to mention the main conclusions flowing from this work. The most important results are discussed in a number of published works by P. Liepins, V. Melnalksnis, V. Ul'st, P. Ul'st, I. Danilans, E. Grinberg and others. In a general form they are also contained in the monographs, already mentioned, that have been prepared for publication to mark the 20th anniversary of the republic. Nevertheless, even what has been written is enough to demonstrate the tremendously rapid

growth in geological investigation during the postwar period. However, the best indication of growth can be got by comparing numbers of workers engaged in geological research. Thus, in 1940 the Institute for the Investigation of Useful Minerals had about 20 geologists, including a number holding more than one position. There were not more than 15 technicians on the staff of the institute. This included a small drilling group. Scientific research work was carried out by the department of geology of the Faculty of Natural Science and Mineralogy and the Faculty of Chemistry of the University, a total of fewer than ten men. At present the Institute of Geology and Minerals has a permanent staff of more than 100, including 41 geologists and 45 specially trained technicians. The Board of Geology and Mineral Resources has more than eight hundred men, including more than 100 geologists and engineers. The Institute and the Board both have well-equipped laboratories. The Board has a large number of drilling rigs, both mobile and fixed, and ancillary transport.

Moreover, many of the republic's planning institutes, the Railroad Board and the Ministry of Highways also have geological departments with a total of not less than 50 geologists and supporting technical staff. Thus, we now have a grand total of not less than 1,000 geological workers, or at least 15 times as many as 20 years ago. And these workers are incomparably better equipped with laboratories and so on.

In Soviet Latvia geological investigation has progressed at a rate no less rapid than that of the economy as a whole. There is no doubt that in the future the geologists will continue to make a valuable contribution to the nation's effort to establish a communist society.

## FORESTRY AND THE NATIONAL ECONOMY

by A. Kalnin'sh and A. Kundzin'sh

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Maximum rationalization and intensification of forestry is immensely important for the Latvian S.S.R., where more than a ten-year norm of the annual growth was being felled during the bourgeois regime in Latvia; this superfelling was more than doubled under the German fascist occupying forces as a result of their policy of predatory felling.

Although, since the liberation of the republic from the Germans, the felling norm has been reduced by half as compared with the pre-war norm (only three instead of six million cu.m), and all the areas previously felled have been re-afforested, the condition of the forests in Latvia is still not satisfactory. It is therefore incumbent on forestry workers to give the utmost attention to the elaboration of a theoretical basis for the development of Latvian forestry and to give every possible assistance to the Ministry of Forestry and Forest Industry in organizing rational forest husbandry and exploitation.

During the 20 years that Soviet Latvia has been in existence much work has been accomplished in this field, and production organizations have been greatly assisted by research workers of the Institute for Forestry Problems and Wood Chemistry. In their work the individual departments of the Institute have been constantly concerned not only with current requirements, but with anticipating them, envisaging and studying problems such as the application of artificial fertilizers in forestry, the modification of the properties of trees in required directions, the elaboration of new methods of selecting trees, etc., making extensive

use of the most recent physicochemical methods in their work.

A series of research theses have been prepared in the Department of Forestry and its Laboratory for Soil Chemistry and Biology; these have dealt with Forestry and Forest Crops (A. Kundzin'sh, S. Salin'sh, Ya. Gailis), the Use of Herbicides in Forestry (A. Eglite), Growing Knot-free Wood (M. Bush), the Chemical and Physical Properties of Soils (V. Kapost), and the Control of Forest Pests (G. Ozol). The results of these researches are being introduced into Latvian forestry.

Work has been in progress in the department since 1950 to find the best methods for afforesting the sand dunes of the Baltic littoral and the bay of Riga. As a result of these researches, M. Bush has developed several methods for preparing soil for growing forest crops by introducing a layer of organic substances (5-10 cm), such as peat, brushwood and lumber detritus, at a depth of 30-40 cm. Experience has shown that even on sites where plantings on unprepared or mere loosened soil are nearly always lost, the afforestation procedures advocated by the Institute will assure well-rooted crops, with an incremental growth much superior to that of the check seedlings.

In biological researches on soils A. Eglite determined the role of mycorrhiza and microflora in the nutrition of trees on poor soils. It was established that with the help of mycorrhizal fungi pine can assimilate nutrient substances both from minerals which are soluble with difficulty and from some partly decomposed organic substances in the soil. Assessment of microorganisms showed that the active microflora aggregate in heath and sand dune soils is 3-4 times less than in white moss heath soil. Organic substances must be used to improve the biological activity and fertility in sand dunes, while for heath soils deep tillage (30-60 cm) is needed, the plant cover being turned in and the surface of the soil spread with ortstein. A year should be allowed after tillage before planting trees. It was established that microbiological processes have a major effect on soil fertility. The decline in the growth of 10-20 year-old pine on heath is attributed to the fact that mineral N is not released, so that growing plants suffer from N deficiency. This was confirmed by field experiments using fertilizers. The results of these studies showed that afforestation of the poorest (dry) heath soils was impossible without fertilizers. The experiments confirmed the expediency of using ammonium sulfate and organic substances as fertilizers for poorly developing pine crops. It was established that

heath microflora is capable of producing up to 40 kg mineral N per ha. in 7 days, so that there is little likelihood of loss of N by leaching. More extensive production experiments were started to determine the economically most suitable kinds of fertilizers and the dosage.

Biological methods designed by the Institute for preparing heath soil have been widely adopted in practice.

In studies on the effect of microelements on the growth of trees it was established that the treatment of pine and spruce seed with microelements - Cu and Co - increases seed germination vigor and enhances seedling development.

In work dealing with the introduction of valuable and fast-growing trees, S. Salmin'sh established that the introduction of larch and poplar into the Latvian forests would considerably raise forest production. European larch (Larix decidua) is an especially promising tree for the conditions of the Latvian S.S.R., and there are plans for its future large-scale introduction into the Republic's forests. It occupies first place for productivity with an annual growth of wood of 10-12 m<sup>3</sup>/ha., while Sukachev larch gives 8-10 m<sup>3</sup>/ha., and Japanese larch (L. leptolepis) 10-12 m<sup>3</sup>/ha. In some forest conditions larch growth considerably exceeds that of the local conifers - pine and spruce. Siberian larch (L. sibirica) under cultivation frequently suffers from the winter frosts, and is highly susceptible to pests and fungus diseases. European larch reproduces itself naturally, especially with mineralization of the soil. At the Rezeke Forestry Establishment, Latvian S.S.R., there are plantations of 40 year-old second and third generation European larch, with a good fruit yield and natural regeneration. These plantations are a valuable seed reservoir for the Republic.

S. Salin'sh and Ya. Smigla have established the most productive species of poplar: Canadian (Populus deltoides), "brown-twig" (P. tristis), balsam poplar (P. balsamifera), Californian poplar (P. trichocarpa), and 4 hybrid forms - P. nigra x P. pyramidalis, P. nigra x P. suaveolens, P. balsamifera x P. berolinensis, and P. balsamifera x P. nigra.

For decorative purposes the most suitable is Professor Yablokov's hybrid poplar - the Soviet Lombardy poplar (P. pyramidalis). Agrotechnics were also developed for planting poplar in the nursery and as crops. Twelve thousand varietal cuttings are provided each year for trial in production conditions.

As a result of studies on the use of chemical controls against unwanted vegetation in forest husbandry,

A. Eglite has developed methods for using 2,4-D (2,4-dichlorophenoxyacetic acid), and 2,4,5-T (2,4,5-trichlorophenoxyacetic acid) for the eradication of alder, birch, willow, and hazel along ditches, in meadows and on pasture; preparation MG-T is suitable for the control of couch grass, and trichloroacetate ammonium sulfanate for preparing soil under forest crops.

This method of controlling undergrowth is being extensively adopted in forestry and agriculture.

Methods for the control of pests of pine plantations have been developed by G. Ozol, and are already being used in forest husbandry. In May 1959 an airplane was used for dusting pine plantations to eradicate cockchafer (Melolontha vulgaris) over an area of 600 ha., 85-100% eradication being achieved.

The Department of Forestry Selection and Seed Breeding only came into being in January 1958. The fundamental task of the Department is to bring to light fast-growing, technically valuable forms of trees with high resistance to pests and diseases already present in the Latvian forests, and to produce new forms by artificial hybridization, to develop practical methods for the reproduction of high quality forms of trees with a view to their extensive use as forest crops, as well as to achieve the principal aim of all foresters i.e. to increase the productivity and value of our forests.

The theme of the research done in the Department corresponds to this task. Under the thesis "The Introduction of fast-growing and technically valuable Trees", members of the department have worked on the following problems:-

1. Black and speckled alder (Alnus glutinosa & A. incana) hybrids and their forestry characters.

2. High-quality forms of Scotch pine (Pinus sylvestris) in the forests of the Latvian S.S.R.

3. Cultivating willow in the Latvian S.S.R.

Detailed study of the morphological, anatomical, and biological characters of a whole range of natural alder hybrids occurring in the forests of the Latvian S.S.R. established that these hybrids are different intermediate forms from black to speckled alder, to a greater or lesser extent showing heterosis, i.e. fast growth and enhanced resistance to adverse growing conditions. Wood from the hybrids is entirely suitable for making plywood. Methods were elaborated for hybrid reproduction both from seed and vegetatively. Various hybrid forms of alder were obtained by artificial crossing, and their characters are still

being studied. In the spring of 1960 various lots of hybrid seed were given to L.O.S. "Kalsnava" and to the nurseries of two forest industry establishments for experimental industrial testing in growing hybrids.

For the classification of high-quality forms of pine the assessment (cataloging) and description of elite pine trees and plantations was made at 16 forest industry establishments.

Extensive trials were made in grafting with scions from the crown of elite pine. Sometimes up to 100% coalescence was achieved in hothouse conditions. Grafting in the open was also quite successful (up to 50%).

Seminars were organized in collaboration with the Ministry for Forestry and Forest Industry for teaching the techniques of grafting and the collection of scions to forest industrial establishment workers.

The apparatus built by Ya. Gailis for getting up growing trees to collect cones, seed and scions must also be accounted a considerable achievement.

Grafting with elite pine at some places was on such a scale that at five or six forest industrial establishments in the spring of 1960 seed plantations of pine were started, which will be some of the first in the Soviet Union.

The basic research on the cultivation of willow was made at L.O.S. "Kalsnava". The development of 18 of the most promising species of willow was studied for three years in different soil conditions, including new species and forms developed at the Institute for Forestry of the Academy of Sciences of the U.S.S.R.

Trials were made of the technical properties of the willow species under test, and it was established that ten species of willow, including the new form "Lambur", are suitable for industrial use.

Practical instructions for organizing willow plantations were elaborated on the basis of these researches.

During these studies the susceptibility of different willow species to pests and diseases, and also to damage by forest animals was determined.

Under the title "Butt rot of Pine in the Latvian S.S.R. and its control" valuable data were obtained on the extent of damage to pine by this fungus (Fomes annosus) in the Republic, on the conditions for its development and spread, as well as data on possible biological and forestry measures for its control.

Studies were initiated in 1959 for developing methods for increasing frost resistance in trees.

In addition to the theme of these planned researches

the effect was studied at the Department of radioactive irradiation of pine seed, and of black alder seed, as well as the effects of colchicine which, according to the literature, is capable of causing the formation of polyploid forms. Experiments are continuing in this direction.

An extensive study was undertaken by members of the Department in collaboration with workers of the Trust for Riga Gardens and Parks to assess the damage done to the Park for Culture and Recreation by chimney gases, measures also being elaborated for improving the park's condition.

Members of the Department also played an active role in organizing the dendrological forest of the Botanical Gardens of the Academy of Sciences at Salaspils.

Prior to the formation of the Department of Forest Selection and Seed Breeding, the following work was accomplished by the present members of the Department (at the Forestry Department).

1. Work was completed on the artificial and natural regeneration of black alder.

2. Researches were basically completed on the rooting of green cuttings from trees and bushes using growth stimulators, 60-80% successful rooting being achieved with such difficult subjects as different birch and hazel species.

3. A new method was developed for the afforestation of the "grinis" (lowland heath). At present over 2,000 ha. have been afforested in this way.

Members of the department have delivered 86 lectures and papers, have given about 100 consultations (visiting the site in the majority of cases), published 3 pamphlets, 38 scientific and popular scientific papers, and 26 newspaper articles.

Eight recommendations and instructions for putting the results of these researches into practice have been given to the Ministry for Forestry and to producer organizations.

The Department for the Economics and Organization of Forestry has existed since May 1946.

In the period 1946-1959, 2 scientific workers, 2 post-graduate students, and 2 scientific correspondents - production workers - have written theses in the Department and received the degree of Candidate of Agricultural Science.

By the 1st. January 1960 scientific workers at the Department had completed 12 scientific research projects which, in accordance with the Department's aims, were mostly complex in character and closely related to Latvia's practical forestry production.

A study on the ways of increasing the yield of matchwood from aspen stands, of importance for the Republic's industry, was completed in 1949. The development of rot on aspen trunks was studied; this strongly reduces the percentage yield of workable wood in aspen plantations. The possibility of sharply accelerating growth in the diameter of aspen trunks was also investigated. On the basis of the data obtained a method was developed which would give technically mature aspen stands at 40-50 years with an increased yield of matchwood. This method was introduced into production in 1950, and on instructions from the Ministry for Forestry, is now also being adopted in (collective) forests. Recommendations were also worked out for forest husbandry on collective farms, and also on state farms, taking into account the individual structure of plantations and the specific conditions for the husbandry of these forests. To test these recommendations, members of the Department cataloged the forests on three collective farms characteristic for the Republic and elaborated a ten-year plan for their husbandry. For the dissemination of these recommendations members of the Department have written and published three pamphlets, a poster for foresters on collective farms and a series of articles in periodicals.

In collaboration with representatives of the Latvian agricultural Academy the Department's scientific workers have developed a new system for the typological classification of forests corresponding to the requirements of the present level of production, and based on the principles of Michurin's biology. This system and the principles for typological classification were considered and emended by the inter-republican Conference held in Riga in October 1953.

The wood sorrel forest vegetation type of conditions most frequently encountered in the Latvian forests was studied in detail. Within this type it was established that three variants must be distinguished, i.e. the lowland, the hilly, and the (sandy?) wood sorrel. The external characters of each variant are described and their economic properties given.

In addition, especially important mention must be made of the work devoted to the study of the structure, growth, and regeneration of spruce stands of different ages which occur very frequently both in collective farm and state forests. As a result of the studies made, it was established that free selective felling should be practiced in spruce stands of different ages on unswamped mineral soils with a predominance of 40-80 year-old spruce. This

gives an approximately 30% increase in the productivity of spruce stands, as well as a considerable increase in the size of the trees being felled. A method was developed for the free selective felling of spruce stands in the state foundation and in collective farm forests. Systematic trials of the method have been made on fixed test plots from 1946, and from 1951 on a production scale in the Gulbeneskoye forest circuit (Gulbenkiy Forestry Industrial Establishment). The free selective felling method is gradually being introduced in the state forest foundation forests, and by 1 January 1960 had already been adopted in the forest husbandry of 150 Latvian collective farms.

Improvement cutting in the Latvian S.S.R. is of especial importance since the amount of wood prepared by improvement cutting and similar sanitary felling is approximately the same as that procured by the main felling. It must also be borne in mind that many tasks of importance to the national economy are fulfilled by improvement cutting, for example: improving the condition of forest plantations, raising the quality of stands, reducing the time for growing technically mature timber, etc. The solution of the problems concerned with the rationalization of improvement felling is further complicated by the fact that each tree and forest type has its own specific variations, so that improvement felling may well not affect the development of a plantation uniformly. For this reason the subject of the rationalization of improvement felling has been treated in sections, and upon completion of the researches on an individual section the results were at once communicated to the Ministry for Forestry and Forest Industry of the Latvian S.S.R. to be applied in production. These researches were made in close collaboration with production workers; consultations were held in the forest each year. Instructions were issued for application in practice on the rationalization of improvement felling in pine and birch plantations on mineral soil, and for forest husbandry in deciduous plantings with second growth spruce.

Members of the Department together with colleagues from a number of other scientific research institutes collaborated in a work to determine the optimum ages for felling pine plantations. This task was successfully accomplished; the conclusions reached formed the basis for determining the age for felling in pine plantations of the state forestry foundation of the Latvian S.S.R.

The completion of two economic studies of exceptional current interest must be mentioned. In one of them the possibility was established of reducing the costs of measures for forest drainage, and recommendations were

made on some problems connected with the organization of forest drainage in Latvian forests.

The purpose of the second study was to ascertain the most suitable types of forest roads and the principles for planning a road network in the Latvian state forest foundation. The recommendations on both subjects have been communicated to production organizations, and are being used in the planning and organization of forest drainage and road-building work.

In addition to these major studies, a series of extra studies were completed, the results of which have also been adopted in production.

Apart from numerous newspaper articles, the members of the Department since its creation have published 73 papers, pamphlets and books, including a monograph on "Spruce and the Spruce Forests of the Latvian S.S.R." (15 printed pages).

Members of the Department have read papers and communications at 15 All-Union and inter-republican conferences dealing with different branches of forest husbandry.

The Department for the mechanization of Forestry Work (called the Department for Forest Exploitation until 1958) has operated from the foundation of the Institute. Initially it had two aims:-

1. The development of a rational technology for sawmills, the drying of forest products in hermetic drying chambers, and the making of slabs from wood shavings and sawdust (this work has recently been transferred to the newly organized Laboratory for the Mechanical Technology of wood).

2. The development of rational procedures and tools for improvement felling. In these studies the following results have been obtained:

a) in accordance with working diagrams developed by the Department for efficient tools for dealing with saws, a whole range of these tools (25,000 pieces) was produced in 1955 at the Galichskiy Maintenance and Mechanical Factory and distributed to all the Forest Industry Establishments of the Soviet Union:

b) in the same year the Kishinev Maintenance Mechanical Factory manufactured 1,800 dies designed by the Department for cutting hand-saw teeth, and these have also been distributed to all Forest Industry Establishments of the Soviet Union:

c) a new high production form of "M-1" saw-teeth was designed, which is at present being widely used in the Forest Industry Establishments of the Latvian S.S.R.:

d) a new straight form of frame was developed for

Frame-saws and for 122 and 107 cm saw blades. The frames are made in accordance with the Department's working diagrams for the use of Latvian Forest Industry Establishments in the consumer goods workshops of the Kuldiga and Riga Forest Industry Establishments;

e) an automotive electric power plant was designed and built which facilitates the complex mechanization of tree felling, cutting out brushwood, hauling long wood and assortments, using radio-controlled winches. The automotive electric power plant was successfully state tested at the Pushkin Machine Testing Station, Moscow region, and declared suitable for forestry work.

f) pincers were designed with an indicator for setting saw teeth, making it possible to set hand saw teeth with an accuracy of 0.05 mm.

g) a "Riga type" axe was designed, which eliminates the possibility of wedging in the log and frequent breaking of the shaft. The Latvian Ministry for Forestry and Forest Industry, with the support of the Council for the National Economy, plans to produce 5,000 of these axes in 1960:

h) a chopper has been developed which is more suitable for thinning and clearing:

1) a portable soil drill "PB-2" was designed on the basis of the "Druzhba" mechanical saw with changeable Ø 12, 15, 20 and 30 cm borers and working parts for hoeing. The drill is extremely important for afforestation on sandy soils and planting seedlings of different ages. Work productivity is increased 2.5-4 times. Working diagrams for this drill were elaborated in 1959. On instructions from the Ministry of Forestry and Forest Industry, in 1960 the Workshop Administration for Light Industry of the Council for National Economy will produce 50 of these soil drills:

j) the construction was developed of a portable mechanical soil hoe for preparing sowing plots and hoeing between the rows in nurseries:

k) a knapsack forest aggregate "RA-1" was designed, provided with a Ø 25 cm disc saw, a chain saw with a bar 31 cm in length, a rotatory blade for mowing grass and shoot growth, and a soil cutter for preparing sowing plots and hoeing between rows. An experimental prototype was produced and subjected to production tests.

The Department is at present developing other working heads for the aggregate - a reaper for mowing shoots and a bark-stripping cutter. In 1960 it is intended to produce 40 experimental aggregates for testing in

production conditions, followed by series output in 1961; 1) a new method was developed mainly for preparing brushwood and branches for transportation by pressing them into solid blocks, all being laid in the same position. An experimental prototype of press "PLO-5" was produced at the "Rigasel'mash" (Riga Agric. Machinery) factory according to the plans of the Special Design Office of the N.W. The press successfully stood up to production tests, producing 12-14 m<sup>3</sup> blocks per shift at a cost of 8-12 roubles per m<sup>3</sup>. The Ministry for Forestry and Forest Industry of the Latvian S.S.R. envisages producing 10 of these presses in 1960 at the "Avtoremles" factory.

The Department has published 3 books, 71 scientific and popular scientific papers, delivered 237 lectures and papers, and 5 other papers at All-Union conferences, given a series of short courses for saw- and motor-men for the "Druzhba" mechanical saw, composed 2 sets of instructions for making frame-saw frames, and for the use of the "2-Sh." die, given more than 200 consultations on the mechanization of improvement felling, soil treatment, the use of felling detritus, the rationalization of felling tools, etc.

The Department participated in competitions announced by the Ministry for Forestry and Forest Industry and the Special Design Office of the N.W., receiving two money prizes and congratulations.

The Institute for Forest Problems and Wood Chemistry has been a constant participant in the All-Union agricultural Exhibition in Moscow, and is now taking part in the All-Union and Republican Exhibition on the attainments of the national economy. On two occasions the Institute has been awarded medals. More than 20 members of the Institute have taken part in the exhibition.